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CIVIL ENGINEERING

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Volume 15 AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852 *Number 8*

AUGUST 1945


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Homer Hoyt was Principal Housing Economist of the FHA, 1934–1940; and Director of Research for the Chicago Plan Commission, 1941–1943 At present he is Director of Economic Studies for the Regional Plan Association of New York, visiting Assoc. Prof. of Economics at M.I.T., lecturer on city growth and structure at Columbia U., and consultant to various organizations interested in housing.

Frank B. Maltby (U. of Ill., B.S. '82) spent two years (1905–1907) in Panama as Division Engr., Atlantic and Pacific Divisions, and Principal Asst. Engineer on the Canal. Soon after the resignation of John F. Stevens as chief engineer, Maltby also resigned, but returned in the employ of a builder of dredging plant, to oversee such plant, which he had himself designed. He also was in charge of the building of the cableways for Gatun Locks.

Leon Zach (Harvard U., A.B., '18, M.L.A. '22) was for 18 years with Olmstead Bros., on land planning and subdivision work in Venezuela, Bermuda, British Columbia, and throughout the U.S. From 1941 to date, he has been Chief of the Site Planning Section of the Office, Chief of Engineers; in 1945 he received the War Department's Commendation for Exceptional Civilian Service.

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John Cyprian Stevens (U. of Nebr. '05, C.E. '28) the Society's President, entered private practice in the Northwest in 1910, joining in partnership with R. E. Koon in 1920 as Stevens and Koon. The firm's work has included valuation, water supply, sewage disposal, design of Army installations, etc. He is also a manufacturer of engineering instruments.

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Volume 15 August 1945 Number 8

Barge Canal to Cross Florida

St. Johns River Route Selected for Channel from the Atlantic to the Gulf

By Harold A. Scott, Sr., Assoc. M. Am. Soc. C.E.

Head, Hydraulic Section, U.S. Engineer Office, Jacksonville, Fla.

A NEW short-cut for water shipment of commodities between ports on the Atlantic Coast and on the Gulf of Mexico has been approved for construction. The Cross-Florida Barge Canal will provide a channel 12 ft deep and 150 ft wide, with five locks, cutting through the state at its narrowest point. Bridges, dams, locks, and considerable excavation are included in the project. Physical characteristics are described by Mr. Scott in this article.

Ever since the first white people settled in Florida, plans have been proposed for a canal across peninsular Florida to shorten the water route from the Gulf of Mexico to the north Atlantic Ocean, and avoid the tempestuous squalls off the Florida Keys. There is hardly a creek or river in Florida that has not been viewed as a potential route for such a canal. On July 23, 1942, as a protective measure against the submarine menace and a postwar benefit to shipping, Congress authorized construction of "a high-level barge canal from St. Johns River across Florida to the Gulf of Mexico," to form a link in the Intracoastal Waterway, and give a saving of about 650 miles in barging between Gulf and Atlantic ports. The canal route chosen follows approximately the adopted alinement for the sea-level Atlantic-Gulf Ship Canal.

The canal plan, as prepared by the Corps of Engineers, proposes a waterway 12 ft deep, 150 ft in bottom width, and 182 miles long, with 5 locks and 3 dams (Fig. 1). Four railroad bridges and five highway bridges are provided in the plan, with 150-ft horizontal clearances and 100-ft vertical clearances in the open position. There will be two ferries at less important highway crossings. The canal route extends from the intersection of the Atlantic Intracoastal Waterway and the St. Johns River, 6 miles from the Atlantic Ocean, up the St. Johns River 89 miles past Jacksonville and Palatka. There it leaves the St. Johns to proceed southwesterly up the Oklawaha River, over the divide, and down the Withlacoochee River to Inglis Dam, whence it takes a more direct route to the Gulf of Mexico.

Where possible the waterway will follow the river valleys. These are wide, subject to overflow during floods, and quite marshy in some areas. The divides to be crossed consist of low rolling hills ranging up to an elevation of 100 ft above mean sea level.

In the St. Johns River above Palatka the canal will cross several of the low necks of land between the river bends. These cutoffs are entirely in soft muck and loose sand. Excavation across the low alluvial or estuarine Pleistocene terrace, which extends into the angle between the St. Johns River and the Oklawaha River flood plains, would be entirely in unconsolidated fine sands, with occasional lenses of soft clay. Deeper borings at the St. Johns Lock site show it to be underlain by greenish, marly clays, with layers of hard dolomite and limestone, probably belonging to the Hawthorn formation. For the most part the excavation would be muck, loose fine sand, and small pinnacles of Hawthorn semi-consolidated marl, clay or hard limestone, or of Ocala limestone, except in the summit section and beyond the Inglis Lock site. In the summit section, excavation would consist chiefly of soft Ocala limestone but with hard layers and some chert, to an average depth of 25 ft, while between the Inglis Lock site and the Gulf it would consist of approximately 10 ft of Ocala limestone.

Core borings $2\frac{1}{8}$ in. in diameter at the Dunnellon Lock site indicated that the material was unsatisfactory for lock foundations. However, it was believed that the rock was disintegrating during the drilling process. Therefore a 36-in. hole was drilled at the site to a depth of 83 ft. An examination of the 36-in. core which was secured by this means revealed that the rock is satis-

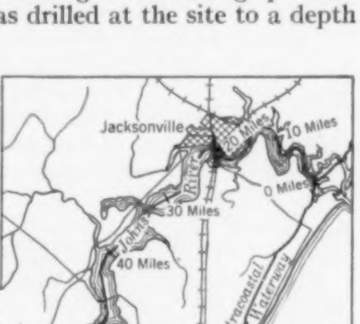
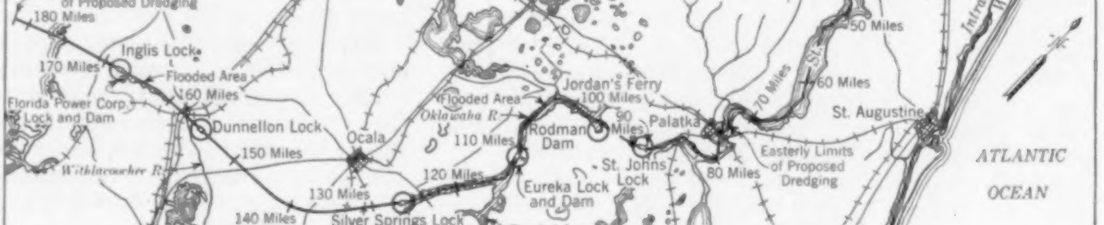



Fig. 1. Route of the Cross-Florida Barge Canal

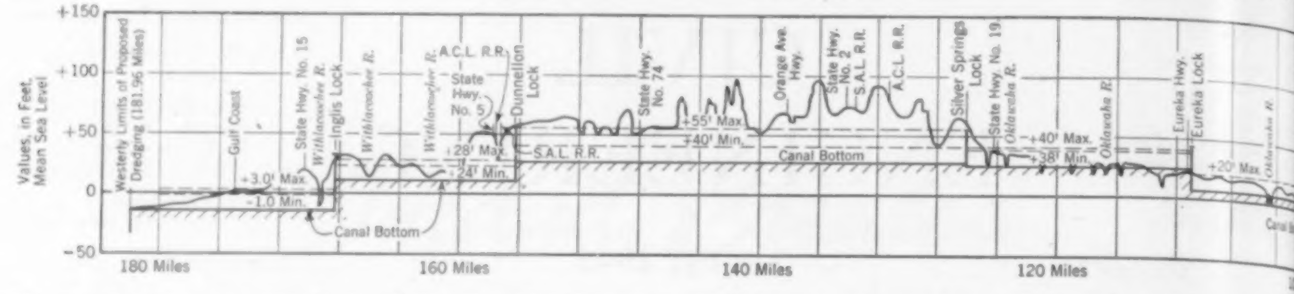


FIG. 2. PROFILE OF THE CANAL INDICATES CONSIDERABLE EXCAVATION

factory for the foundations of the lock, having cavities of small lateral extent.

The canal route from the St. Johns River at Palatka to its western terminus in the Gulf of Mexico will be 107 miles long, of which about 100 miles must be excavated. The magnitude of the land cuts is shown in Fig. 2. The project depth, with overdepth and advance maintenance where necessary, will extend over a bottom width of 150 ft throughout, except where special conditions warrant otherwise. Mooring basins 75 by 1,500 ft are provided in the plan at each end of the locks, for tie-ups during breakdowns for vessels awaiting passage through the locks. Smaller basins would be located at critical points along the canal.

SIDE SLOPES AND PROVISIONS FOR DRAINAGE

Side slopes will be generally 1 horizontal to 2 vertical in rock, 3 horizontal to 1 vertical in earth to a point 4 ft above maximum water surface, and $2^1/_2$ horizontal to 1 vertical above the 3:1 slope (Fig. 3). Berms will be provided at the rock surface where the rock cut is greater than 5 ft and the depth of overburden is greater than 10 ft. A berm at least 75 ft wide will slope from the top of the canal cut to the near edge of the spoil banks. Runoff from spoil banks, surface berms, and back country will be diverted away from the canal by grading and ditching wherever practicable. Where necessary, openings will be left in the spoil banks for drainage into the canal, and structures for runoff control will be placed in the berms and down the canal slope.

In general, there will be no revetment protection against wave wash where the height of the bank in soft material is 20 ft or less above the water surface. Where protection is necessary, it will consist of a combination of porous concrete and riprap. The porous concrete will extend from 4 ft above maximum pool elevation down to the water surface elevation at the time of construction; and riprap will then continue to 4 ft below the minimum pool elevation. The porous concrete will consist of a 6-in. slab on 6 in. of filter material, whereas the riprap will be a 2-ft layer of well-graded stones on 1 ft of filter material. Grass will be planted above the porous concrete to the top of the canal slopes to prevent erosion. Grass will also be provided, beginning at the water's edge, on all unriprapped banks over 5 ft high.

Land required for the barge canal amounts to approximately 81,000 acres, based on a mile-wide right-of-way and including pool areas, and is to be provided by the Florida Ship Canal Authority as a measure of local cooperation. Of this total, about 79,000 acres are swamp, cut-over pine, scrub, and open water. Reservoir pool areas, except the more remote ones, will be cleared to eliminate mosquito breeding and reduce debris.

The five locks in the system will be 75 by 600 ft, with a minimum depth of 14 ft over the sills. The locks and appurtenances are similar in design, and many parts will be interchangeable. The main differences are in height of lift and in foundation treatment. The three locks on the east slope will have pile foundations, and the two on the west slope will rest on limestone. The respective lifts are shown in the profile, Fig. 2. Miter gates with strut and sector operating machinery are specified. The size of gates is standardized as far as practicable.

The lock hydraulic system is designed for side-wall filling and emptying, using Tainter-type valves throughout on the 10 by 10-ft culverts. The 20-ft lock lift will require 7.1 min in filling and 7.5 min in emptying. The 28-ft lift will require 8.1 min in filling and 9.2 min in emptying. The culvert valves will open in 3 min, allowing a maximum rise in the lock chamber of about 6 ft per min. Naturally, it is desired to obtain as fast operation as possible without causing disturbances in the lock chamber.

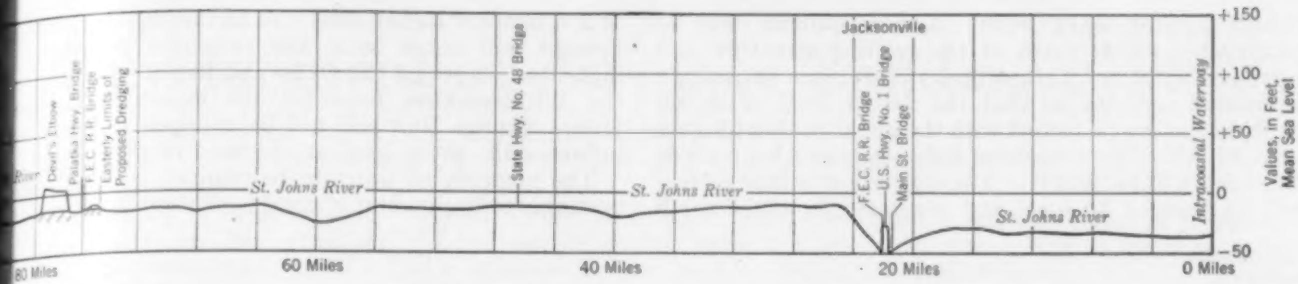
Recent tests on three models of manifold lock-filling systems with side ports and with bottom laterals have indicated that the most critical condition in locks, as manifested by surging and the consequent hawser pull on a craft in lockage, occurs at the beginning of the filling period, before the valves are fully opened and before uniform flow has been established in the system. It was found in the model tests that disturbances are minimized as much as 50% by eliminating the ports from the upstream end of the lock for a distance equal to about 25 to 30% of the lock length.

This behavior is apparently caused by the fact that the initial wave produced in the lock chamber is generated by the flow introduced by the first port or lateral in the manifold system, and if this first unit is located some distance below the upper miter gate, the wave is divided, part of it traveling upstream and part downstream. However, if the first port is located near the upper miter gate, the wave can only travel downstream and is augmented as each succeeding port comes into play. As a result of these studies, the design provides that the first upstream port be located 200 ft from the upstream pintles, followed by 19 additional ports in each wall, on 13-ft centers in the downstream direction.

HYDROLOGY OF AREA

The total drainage area of the Oklawaha River basin is approximately 2,300 sq miles, of which 950 contribute effective surface runoff to floods. The difference (1,350 sq miles), including 150 sq miles of connected lakes, is either landlocked or the runoff is so retarded that it does not contribute to the peak flows associated with large floods.

Silver Springs, the water supply for lockages, is the surface outlet of an underground stream which drains a large area of upland ridge country west and north of the Oklawaha River and discharges through Silver Springs Run into Eureka pool at Mile 124 on the canal alinement. The flow of the Springs varies from 554 to 2,670 cu ft per sec, averaging 875. Stages range between Els. 39.2 and 45.0 ft.



The Withlacoochee River drains about 2,200 sq miles ong the western side of the upland ridge, of which about 686 sq miles are flood producing. During flood periods e river flows through a myriad of small shallow lakes d swamp areas known as Tsala Apopka Lake. At unnellon the river is joined by Rainbow (Blue) Springs un, and then discharges into the reservoir of the Florida ower Corporation near Inglis, which has upper pool evations ranging from 24 to 28 ft.

Rainbow (Blue) Springs, an underground stream milar in character to Silver Springs, drains an area to e north and east of Dunnellon. This flow is utilized r production of power at Inglis and is not considered ecessary for lockages at the present time. Flow from e Springs varies from 490 to 930 cu ft per sec, averaging 92. Stages range from Els. 30.1 to 33.2 ft.

Design storms for the spillway were determined by e unit hydrograph method using a design unit hydroaph determined from actual storms of record. The esign rainfall was selected from the storm that occurred n August 1940 over Louisiana. Particular attention is irected to the design hydrograph, which peaks in 5 and 5 days and lasts for over 60 and 110 days on the klawaha and Withlacoochee rivers, respectively. These ong periods result from flat slopes and the large amount f valley storage in the basins.

THREE DAMS REQUIRED

Three dams will be required for the canal. Those t Rodman and Eureka on the Oklawaha River will be f the low rolled-fill type, with porous concrete revetment. This revetment is to be 10 in. thick on a 6-in. lter blanket on both the upstream and downstream lopes of Eureka Dam, but only on the upstream slope f Rodman Dam. For both dams the crown width as esigned is 25 ft, with side slopes generally 1 vertical n 3 horizontal, as determined from model studies and he characteristics of the soil. Concrete spillways, opped with Tainter gates to maintain pool levels and ass the flood flows of the Oklawaha River, will have tilling basins with floors 4 ft thick in addition to 1 ft f porous concrete on 1 ft of filter material. At Inglis n the Withlacoochee River, the existing dam of the Florida Power Corporation is to be improved and additional spillway capacity added to insure the safety of he navigation pool.

Rodman Dam is to be 6,650 ft long and have an average height of 22 ft with its top elevation at 28 ft above mean sea level. Over the flood plain there is a surface layer of muck which averages 10 ft in thickness except in an old filled stream valley, where it thickens to an average of 20 ft and a maximum of 40 ft. All muck is to be removed from the dam foundation, which is to be backfilled with more suitable foundation material.

The Rodman spillway is designed to pass a maximum flood of 62,100 cu ft per sec. Its crest is to be at El. 6 ft; its effective length is to be 360 ft; and its pool elevation, not to exceed 22.3 ft. With all gates wide open, flow will be as through a chute, obstructed only by the gate piers. The high velocities developed will be confined to concrete approach and discharge aprons, and reduced to less than 5 ft per sec at the approach end by flaring, and at the discharge end by lowering of the apron floor on a gradual slope from gate crest to end sill, which will have a short upsweeping curve. The riprap downstream of the end sill will have a slope down of 8 ft horizontal on 1 ft vertical for the total distance of 40 ft. Aquatic plants and trash accumulating in the pool will pass over stop-logs inserted to near pool height in one gate bay, with the gate in the raised position.

EUREKA DAM

Eureka Dam will be 3,830 ft in length, including the lock and spillway, and have an average height of 28 ft with the top elevation at 48 ft above mean sea level. The flood-plain deposits, which underlie most of the site, consist chiefly of fine alluvial sand, with numerous interbedded lenses or discontinuous layers of peat, muck, silt, and clay—all soft. Under the middle half of the dam site there is a buried lens of variable beds of soft peat, muck, and clay with a maximum thickness of 40 ft, overlain by about 15 ft of sand. Since it is impracticable to remove the muck from such a depth, the design provides for flattening the side slopes of the dam in this section to distribute the load and reduce pressures to within the bearing capacity of the foundation material.

The Eureka spillway has been designed to pass 25,400 cu ft per sec with the crest at El. 30. It is to have an effective length of 180 ft, and a pool elevation not to exceed 43 ft. The stilling basin will be of the conventional type, with a sloping apron, two rows of baffles, and a stepped end sill. The discharge channel will be protected by riprap and the approach channel by riprap and derrick stone.

As for the existing Inglis Dam, it consists of an earth embankment, two concrete spillway sections, a small navigation lock, and a hydro power house. The dam has deteriorated so that the crest is narrower, and the upstream slope flatter, than designed. Of the original five Tainter-gate bays 20 ft long, one has been closed by a concrete wall and one has been transformed into a forebay for a new vertical power unit not included in the original plant design. The three intermediate bays are equipped with wooden Tainter gates, and these provide the total usable spillway length of approximately 60 ft, having a capacity of 11,700 cu ft per sec. The south spillway was originally built as an overflow dam with crest elevation at 24, but later, on top of this spillway, a concrete parapet wall was built, and an earth fill rests against this wall on the upstream side. The dam in its present state lacks the height and side slopes to give it the factor of safety applied in the design of the Rodman and Eureka dams. It also lacks gates and equipment to control the computed maximum discharge.

To obtain the necessary factor of safety, riprap will be provided on the upstream face to the top of the dam at El. 32, and additional freeboard will be secured by constructing a concrete parapet wall to El. 36 as a pro-

tection against wave wash. A new spillway will be constructed 150 ft north of the existing structure and equipped with two Tainter gates 30 ft wide to provide additional capacity so that the design flood of 28,000 cu ft per sec can be passed with the upper pool not higher than El. 28. The maximum tailwater elevation for this condition will be 19.8 ft. The concrete overflow section will be founded on rock, and separated from the earth dam by concrete retaining walls flared on the upstream side. A stilling basin extending 128 ft from the spillway crest will be provided to dissipate high velocities by forming a hydraulic jump.

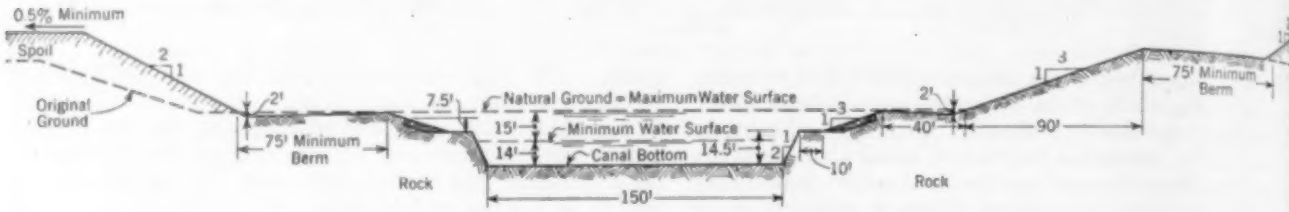


FIG. 3. TYPICAL CROSS SECTION OF THE CANAL IN ROCK CUT

WATER SUPPLY FOR THE CANAL

Plans provide that the water supply for the canal will be derived from the flow of the Oklawaha River and Silver Springs into the Eureka pool. After the water requirements for Eureka Lock are satisfied, water from the pool will be pumped into the summit pool for operation of the summit locks. The water used by the Silver Springs Lock will return to the Eureka pool, but that used at the Dunnellon Lock will pass down the Withlacoochee River to the Inglis Lock. Because of the higher lift of Inglis Lock, it will be necessary to pass an extra amount of water through Dunnellon Lock to provide the full lockage requirements when the flow of the Withlacoochee River is not substantially greater than the hydroelectric power-plant demand. A design based on this conservative assumption takes no account of the water that is now used, or might be used, at the existing lock at the Inglis Dam.

As a basis for design, continuous use at the rate of 36 lockages a day was assumed, which is about the maximum rate at which vessels can be passed through the locks. For estimating purposes, it was assumed that, owing to the saving of water due to alternating lockages up and down, only 27 lockfulls of water would be used at each lock for 36 lockages. The minimum average monthly flow of the Oklawaha River and Silver Springs into the Eureka pool is 689 cu ft per sec; the maximum water requirements for 36 lockages is 636 cu ft per sec. In the event of future construction of twin locks, sufficient water could be obtained by constructing a pumping plant at Dunnellon Lock to draw water from the Withlacoochee River, whose minimum average monthly flow is 702 cu ft per sec.

Inflow into the summit section from the ground-water reservoir will not be utilized for lockages. Water lost from the summit section as a result of lockages and leakage will be replaced from the Eureka pool by pumping. The water surface of the summit section will be free to fluctuate with the normal rise and fall of the ground water, which is observed at numerous wells.

The water level in Silver Springs can continue to fluctuate within its normal range (El. 39.2 to 45.0). The Eureka pool, designed for a minimum elevation of 38 and a normal one of 40 ft, will be regulated so as to permit the Springs to fall to its normal minimum during dry periods or, if it is found more desirable, to hold it at a somewhat higher level. A further benefit to Silver Springs will result from the reduction of extremely high flood stages on the Oklawaha River. The stage of the Withlacoochee River at the mouth of Rainbow (Blue) Springs Run will not be changed and does not influence the water level at the head of the Springs.

The quantity of water to be pumped is directly proportional to the amount of canal traffic and the differences in canal levels at the locks. High-water levels in the summit section will require that greater volumes of water be pumped against greater lifts, while low summit water levels will require less water at lower heads. For about 98% of the time the quantity of water pumped will be the sum of that needed for the Inglis and the Silver Springs Lock. The total pumping head is equal to the lift between the Eureka pool and the summit pool, plus head losses in pumping between the two levels. The pump capacity provided is based on use of water at the rate of 27 lockfulls a day, with a maximum demand of 656 cu ft per sec. The maximum lift of 15 ft, plus head losses in pumping, will occur during the period requiring maximum volume. For over 50% of the time, the difference in level between the Eureka and the summit pools will be between 8.5 and 10.5 ft. The corresponding quantities pumped will be 554 and 580 cu ft per sec. For 70% of the time, the head will vary from 8.5 ft, the pumpage for the latter lift being 594 cu ft per sec. The minimum lift and discharge will be 4.8 ft and 501 cu ft per sec, respectively, when the Eureka pool is at the minimum elevation of 38.0, with the summit pool at El. 42.8, the lowest of record. The plant is designed, however, for operation with a minimum summit pool of 40.

Five pumps, each capable of delivering 60,000 gal per min, or 134 cu ft per sec against an 18-ft head, will be required to supply the maximum pumping demand. The use of five pumps will give the desired flexibility of operation. No standby or spare pump is contemplated, since four pumps will take care of the maximum requirements for about 94% of the time. The pump house will be 70 ft north of the Silver Springs Lock, and the entrance and discharge channels will lead from the canal below the lower guide wall and above the upper guide wall, respectively. The pump house will be 90 ft long, 58 ft wide, and 27 ft high from the operating floor to the roof, and of concrete and steel construction. The substructure will rest on a timber pile foundation and be so constructed as to permit unwatering of any pump chamber without interference with the operation of the other pumps. A reinforced concrete conduit, 11 by 11 ft in section and 864 ft long, will carry the water from the pump house to the summit pool.

Construction of the Cross-Florida Barge Canal will provide a postwar project employing thousands of men and millions of dollars worth of equipment. The problems to be encountered will demand the best of engineering skill, but the benefits will be far reaching, since it will provide a short-cut for the shipment of commodities between the Gulf of Mexico and the Atlantic Ocean.

Development of Airplane Landing Mats

By Raymond L. Tolbert
Civil Engineer, Office of the Chief of Engineers, Washington, D.C.

Air power, coordinated with land and sea forces, has won objective after objective for our military forces. Vitally important are the landing strips which follow directly behind—indeed in some cases lead—the advancing units. Rapid construction is essential and so strips have been put in operation within 24 hours after a landing has been made. Such speed is made possible by prefabricated mats which can be laid on a quickly leveled subgrade. Development of these mats is Mr. Tolbert's subject in this article.

A ROADWAY of steel around the world at the equator could be constructed with the eel landing mats that have been oduced to date. This quantity presents a cost in excess of 00,000,000! Yet the approximate st of the development of the erced plank is less than 0.3 of 1% the cost of the quantity procured date, which represents a weight approximately 2,000,000 tons. his tonnage of steel would have ilt approximately 650 tenousand-ton cargo ships.

The credit for the development of this outstanding ntribution to the war effort should be equally divided nong the technical personnel of the Engineer Board r their direction of development and testing; the ffice, Chief of Fngineers, for planning, coordinating, d consultation; the Army Air Forces for making rvice tests and rendering valuable technical criticism; d the steel and fabricating industries for their technical sistance and splendid cooperation in other ways.

PROBLEM ASSIGNED TO CORPS OF ENGINEERS

The problem of developing such an emergency landing at was assigned to the Corps of Engineers on request f the Army Air Forces during the latter part of 1939. he work was begun at Langley Field, Va., by the Corps f Engineers, but was later transferred to the Engineer oard, Fort Belvoir, Va., the duly authorized War epartment development agency for engineer equipment.

The only data available were on the landing mat being eveloped jointly by England and France. These two llies, in 1939, had produced a prefabricated steel mat nown as the "Cheveron" grid. This consisted of ngitudinal T-sections interconnected with a zigzag ar forming a herringbone-pattern type f panel. The panels were connected in he field by means of bolts and nuts. fter the initial use of the "Cheveron" rid, it became evident that it was unatisfactory because of the time required r field assembly and the serious damage nflicted on airplane tires during landings nd take-offs.

In organizing the plan of development, originally appeared that both a light ype and a heavy type were necessary. he light mat was for airplanes not exceedng 10,000 lb and the heavy one for those ot exceeding 50,000 lb in gross weight. t was determined that the development f the two types should be pursued along ither of two lines: (1) a deck or solid "thin steel plate," and (2) a grid or openesh design. It was recognized that one f the principal problems in the developent program was the design of a satisctory field connection for the individual heets or panels with a minimum number f parts. The mat had to be capable of eing expeditiously connected in the field and of sufficient strength to permit load transfers from panel to panel without failure.

It was further recognized that actual stresses imposed on a landing mat during field operations were indeterminate because of the many variables, such as wheel-load differentials, uplift of the plane when in motion, variable friction coefficients and drag of the mat, differences in bearing capacities of the various soils with different moisture contents, variable magnitudes of horizontal thrust produced by emergency braking action of the plane, etc. Therefore it was obvious that the problem would have to be approached from a trial-and-error method of determination.

An examination of the problem indicated that all mats must possess two general characteristics—speed in laying and a weight not exceeding 150 lb for the individual panel. For emergency uses, a light mat runway 150 ft by 3,000 ft in size should be capable of being laid within 24 hours, and a heavy one (150 by 5,000 ft) should be laid within 72 hours. The weight of 150 lb for the individual panel was arbitrarily determined as the maximum that two men could conveniently handle during the laying operations without becoming fatigued. Later, the maximum dimensional limits of a sheet or panel were set as not exceeding 12 ft in length and 3 ft in width. These limits were selected after considering the transportation facilities that would be available in the field.

After the basic concepts for the emergency landing mats were determined, representatives of the steel, grating, and wire industries were called in and their help was solicited. They were advised to consider the development either of a "thin steel plate" or of an open

Base for Bombers Prepared by Seabees in the Pacific

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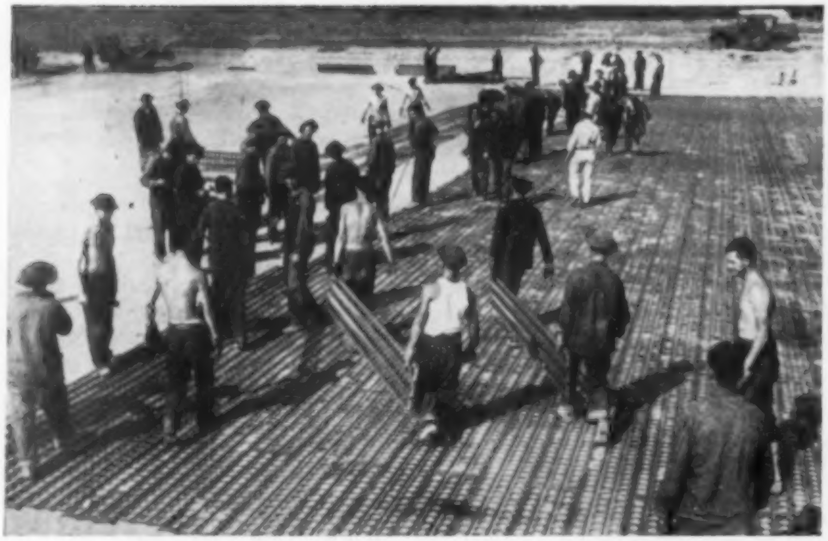


PLANKS ARE EASILY CARRIED AND PLACED BY TWO MEN

mesh or grid design. In addition they were told that the weight per square foot should not exceed 5.0 lb for the heavy mat and $1^2/_3$ lb for the light mat. The steel, grating, and wire industries are to be commended for their magnificent response to this call. As a result of their cooperation, many mat designs and ideas were presented to the Corps of Engineers for consideration.

In order that the many types of mat submitted by participating industries could be adequately evaluated, the mats were subjected to a two-phase engineering test and, if warranted, to a service test. The engineering tests usually indicated the inherent structural adequacy or design deficiency, whereas the service test indicates mat behavior under airplane traffic. The laboratory phase of the engineering test consists of bend tests, shear or tensile tests of the interlocking connectors and, if necessary, a physical and chemical analysis of the metal. The stress-strain data obtained from the bend tests were compared with those for other mats similarly tested.

The second phase of the engineering test consisted of a limited truck-traffic test on one particular mat. A quantity of approximately 1,000 sq ft of experimental mat was laid on a silty clay soil and subjected to the repeated traffic of a loaded truck whose gross weight was approximately 18,000 lb. This phase of the test usually indicated the strength of the connectors as well as the behavior of the mats under repeated loads. The traffic test was later expanded in scope to include wheel loads of 15,000, 37,000, and 60,000 lb.

The service test on a landing mat consisted of laying a runway 150 ft in width by 3,000 to 6,000 ft in length, depending on whether the mat under test was the light or the heavy type. The mat was then subjected to the traffic of airplanes ranging in weight and size up to the heavy bombers. Observations were made on: (1) structural adequacy under loads (static and dynamic); (2) brake action; (3) skidding characteristics; (4) tire abrasions; (5) time checks on laying operations; and (6) general efficiency of the mats. The service test determined mat efficacy under plane traffic.

By the engineering and service-test methods many mats presented by the industries were screened out because of design deficiencies. The mats that were found unsatisfactory included 12 steel grids, steel planks, 4 wire types, 4 wood types, 1 old-tire-rubber door mat, and 1 impregnated coco-fiber mat. The steel-grid designs included small box channels, double T's, double bars, bars and rods, riveted angles, and automobile moulding strip designs.

By January 1941, three types of mats had gone through a period of design evolution as a result of the engineering tests and gave evidence of being satisfactory. Therefore plans were made for service tests of these types—the "thin plate" or pierced plank, the Irving grid, and the heavy bar-and-rod mats. Twelve service tests were made on the landing mats laid on the four basic ranges of soils—sand, clay, silt, and loam. These 12 tests proved the structural adequacy and feasibility of mats for use in theaters of operations. Since the various development stages which the three mats passed through were similar in nature, only those of the pierced plank will be described.

The first "thin plate" design suggested by a steel company was the conventional sheet-piling section, with reduced section modulus. This section was dropped from further consideration because of its excessive weight and insufficient method of connection. The next design considered by the Corps of Engineers was a solid plate section, formed from No. 12 gage metal. The plates were connected by a bayonet and slot arrangement, one plate having the bayonets along both sides, while the other plate had slots along both edges. The next step in the "thin plate" evolution was to place a row of bayonets along one side of the plate and a row of slots along the other, thus giving each plate a combination of the two types of connection. The next design change was to incorporate both types of connection on each side of a No. 10 gage plate by alternating bayonets and slots.

Next, "raised-button" indentations were added in the surface of the planks. These "raised buttons" were to overcome the tendency of airplanes to slide when landing on a wet runway by providing additional traction on the mat surface. The last step in the evolution of the pierced-plank design was to incorporate tubulated holes in order to add increased rigidity, to permit camouflage

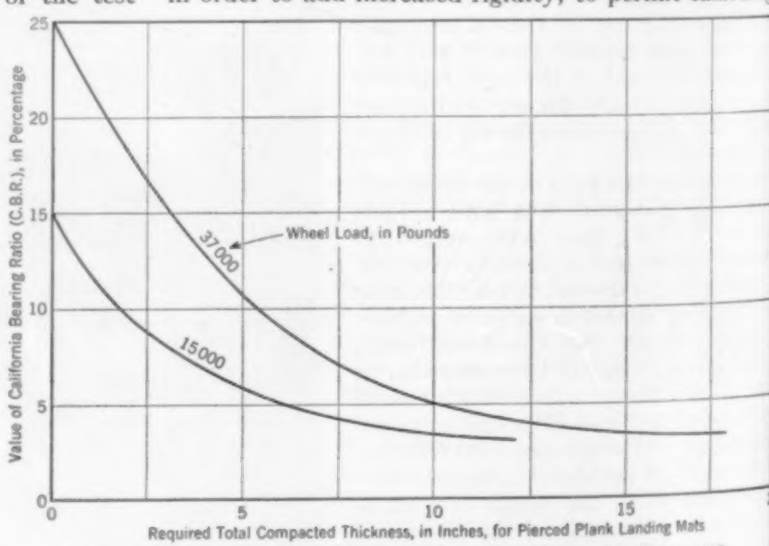


FIG. 1. MINIMUM BASE-COURSE REQUIREMENTS FOR RUNWAYS WITH PIERCED-PLANK MAT SURFACE

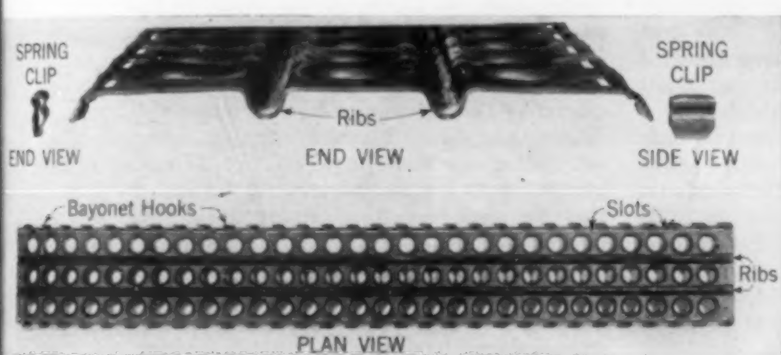
by the growth of natural vegetation, and to materially decrease the weight of the plank.

The mat in its present form is officially known as the "steel pierced plank" and may be described as being a mat formed from a No. 10 gage, low-carbon-steel sheet into a panel 10 ft in length and 15 in. in width, reinforced by two longitudinal ribs $^3/_4$ in. in depth, pressed into the sheet. Three parallel lines of holes $2^5/_8$ in. in diameter, spaced on 4-in. centers, are pierced and tubulated into the sheet on each side of the ribs. The panels are connected by locking bayonets, and keyed with spring clips. The mat weighs approximately 5.15 lb per sq ft.

LAYING PIERCED-PLANK RUNWAY ON A PACIFIC ISLE

The mat is packed for shipment into master bundles composed of six sub-bundles. Five sub-bundles contain five 10-ft planks each. The sixth sub-bundle consists of four 10-ft and two 5-ft planks. Each master bundle contains 375 sq ft of mat together with spring clips, weighs 1,928 lb, and has a volume of 16 cu ft.

The Irving grid, after many design changes, may be described as being constructed of longitudinal and reticulated bars 1 in. by $^3/_{16}$ in., riveted together into panels 12 ft 6 in. in length by 1 ft 10 in. in width, weighing 5.5 lb per sq ft. The panels are interconnected by means of slip bands along the outside perimeter of each panel.



AIRPLANE LANDING MAT OF PIERCED STEEL PLANK TYPE

The third mat, the heavy bar-and-rod grid, in its present form may be described as being constructed of $^3/_8$-in.-diameter transverse rods on 4-in. centers, pressure-formed and resistance-welded into 1-in. by $^3/_{16}$-in. longitudinal bars spaced at 4-in. centers, making a panel 12 ft long by 3 ft wide, weighing 3.9 lb per sq ft. The panels are connected by means of fixed wing connectors and slip bands spaced along the perimeter of the panels.

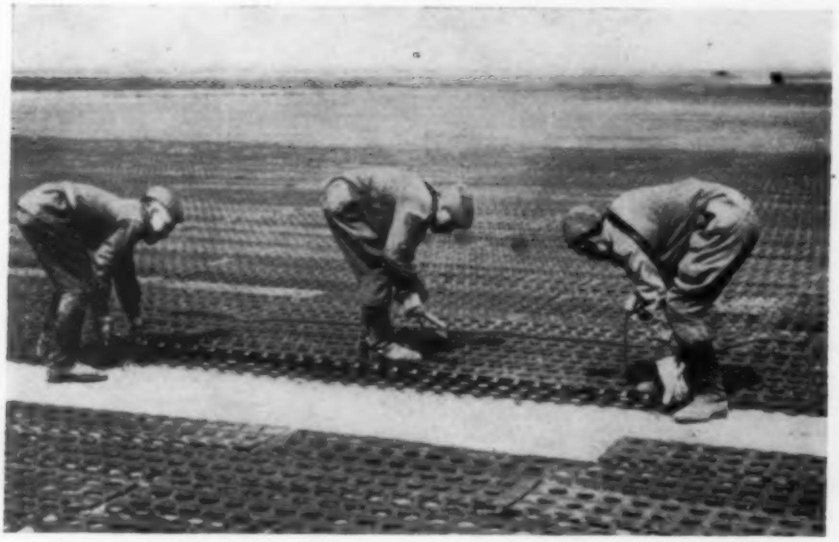
Two light steel landing mats were being developed by the Corps of Engineers concurrently with the development of the heavy steel mats. These were originally intended for use by light pursuit and observation planes. One mat, as finally developed, is known as the light bar-and-rod and is similar in design to the heavy bar-and-rod except that the transverse rods are $^1/_4$ in. in diameter and the longitudinal bars are $^3/_4$ in. by $^1/_8$ in. This mat weighs 1.9 lb per sq ft. The other mat, known as the Sommerfeld type, was first produced in England and was being subjected to design improvements for lend-lease requirements. This mat consists essentially of No. 12 gage hexagonal or triangular wire mesh 10 ft $4^1/_2$ in. wide, reinforced by $^3/_8$-in.-diameter rods interwoven on 8-in. centers. It is provided in rolls with the required amount of accessories, such as metal stakes, etc. The mat weighs approximately 1.2 lb per sq ft.

Although the landing mats had the general military characteristics required, it was evident that further investigations should be made on their capacities and on base-course requirements for wheel loads of 15,000, 37,000, and 60,000 lb. Implementing an investigation of this nature was the fact that landing mats were either being, or would be, tactically employed in the "four corners" of the earth on various soil conditions.

Accordingly, the Chief of Engineers, in cooperation with the Headquarters of the Army Air Forces and the Engineer Board, planned an extensive investigation program, with emphasis on correlating mat capacities under different wheel-loads with various soils and base courses having variable ratios according to the California Bearing Ratio test. These C.B.R. tests were made on the soil at the field density and moisture occurring during the test. The California Bearing Ratio may be described as the ratio of resistance to penetration of a soil as compared to that of crushed stone, measured by a piston with 3 sq in. of bearing area applied at the rate of 0.05 in. per min. (See articles in CIVIL ENGINEERING for March and May 1945.)

The field testing was assigned to the Flexible Paving Laboratory, Waterways Experiment Station, Vicksburg, Miss. In planning the scope of the investigation, all procured mat types, except the Sommerfeld, together with a few promising experimental types, were included in the test.

The conclusions that were drawn from these comprehensive tests may be summarized as follows: (1) the pierced plank and heavy bar-and-rod grid mats were equal in performance and superior to the other steel mats; (2) the use of pierced plank or heavy bar-and-rod mats effects an appreciable reduction in base-course requirements for wheel loads of 15,000 and 37,000 lb only; (3) pierced plank of bar-and-rod grid, when laid on a thick base course of clean sand or gravel will support a 60,000-lb wheel load; (4) the laminated wood, an experimental type, gave a performance superior to that of any steel type tested. (This mat is constructed by



NO RESPECTER OF CLIMES, STEEL PLANK IS PIECED TOGETHER BY RUSSIANS ON THE EASTERN FRONT

nailing together 2 by 4-in. lumber with the 4-in. dimension vertical, lapping the ends from $1^1/_2$ to 3 ft, and filling the interstices with subgrade material.)

No base course appears to be justified for the laminated wood mat. The subgrade requirements without base courses for this type of mat are as follows:

WHEEL LOAD	MINIMUM C.B.R.
15,000 lb.	3%
37,000 lb.	7%
60,000 lb.	12%

The Vicksburg tests further revealed that the greatest divergence in traffic-carrying capacity of clay and silt soils occurred at the higher C.B.R. values, which do not have a great deal of influence on the thickness of base course required. However, it was determined that compacted base courses were required for steel mats on soils having low C.B.R. values, particularly if operations with wheel loads of 15,000 or 37,000 lb are anticipated for one or more years. The adjusted thicknesses of compacted base course required for soils having C.B.R. values ranging from 3 to 25% when used in connection with steel mats, are graphically shown in Fig. 1.

PIERCED PLANK STANDARD

As a result of the satisfactory performance of the pierced plank during the service tests, and the favorable operational reports received from theaters of operations, the Corps of Engineers adopted the pierced plank as the standard type of landing mat. This decision was influenced in part by the confidence engendered in the Army Air Forces as to its operational performance. The heavy bar-and-rod and the Irving grid mats were declared substitute standard types and their production was canceled. Reports from theaters of operations indicated that tactical necessity required advance emergency landing mats to be of sufficient strength to sustain the loads of all weights of airplanes. Therefore the light bar-and-rod and the Sommerfeld mats were declared limited standard types and their production also was canceled. All efforts were concentrated on fabricating the pierced plank. Although this has been adopted as the standard type, development is continuing in an effort to overcome minor objectionable features it possesses.

Military characteristics have been established for all metal landing mats. These include weight, size, surface, bundle weight, cubage, accessories, speed of laying, ease of camouflaging, deterioration, replacement, rehabilitation, and strength. The strength characteristic requires that a mat have a supporting value equal to 6 in. of stable, well-compacted base course (C.B.R. 65–80%) when the base of required T.O. (theater of operations) thickness is built on a subgrade with a C.B.R. of from 4 to 8% and the surface subjected to a rolling wheel load of 15,000 lb for approximately 12 months (1,000 coverages). The T.O. base thickness requirements are 35% less than those for permanent airfield installations.

LIGHT METAL MATS

In addition to the development of steel mats, investigations are being made of light metal landing mats. These are for use in areas where transportation facilities are critical or for air-borne operations. Many experimental light metal mats made from magnesium alloys and aluminum alloys have been considered. One aluminum alloy mat is now in production and reaching the theaters of operations. This is similar in design to the pierced steel plank, and is formed from alloy sheets of 0.188-in. gage. The alloy has a high ductility characteristic that lends itself to forming operations. After the mats are fabricated, they are thermal treated for eight hours at approximately 350 F to increase the physical properties of the aluminum and make them comparable to those of the steel in the pierced-plank mats. The weight per sq ft is 2.56 lb as compared to 5.15 lb for the steel mats.

The necessity for a light metal mat can best be appreciated by the experience in the Southwest Pacific theater. During the New Guinea campaign, when the Japs were advancing up the Owen Stanley Mountains, an emergency runway was constructed behind the Jap lines by the Airborne Aviation Engineers at Dobodura. The fighter planes operating from this emergency runway severed the Jap supply line. This operation is credited as being a major factor in turning the tide of battle. The landing mats as well as all construction equipment, supplies, and troops were flown in by cargo planes. Had aluminum mats been available for the air-borne operation, an appreciable saving in the number of cargo-plane trips required for landing mats alone could have been effected. The number of cargo-plane loads (C-46's or C-54's) required to transport steel mat for a runway (150 by 5,000 ft) is 322 as compared to 163 for the aluminum mats.

There have been many interesting related developments that have become necessary during the course of the landing-mat development program. These related developments have carried limited research into various metals such as aluminum alloys, magnesium alloys, and Bessemer steel. The principal related developments are (1) protective coatings (paint), (2) rehabilitation plants for pierced-plank mats, (3) various anchoring devices and tools, and (4) dust alleviation measures, etc.

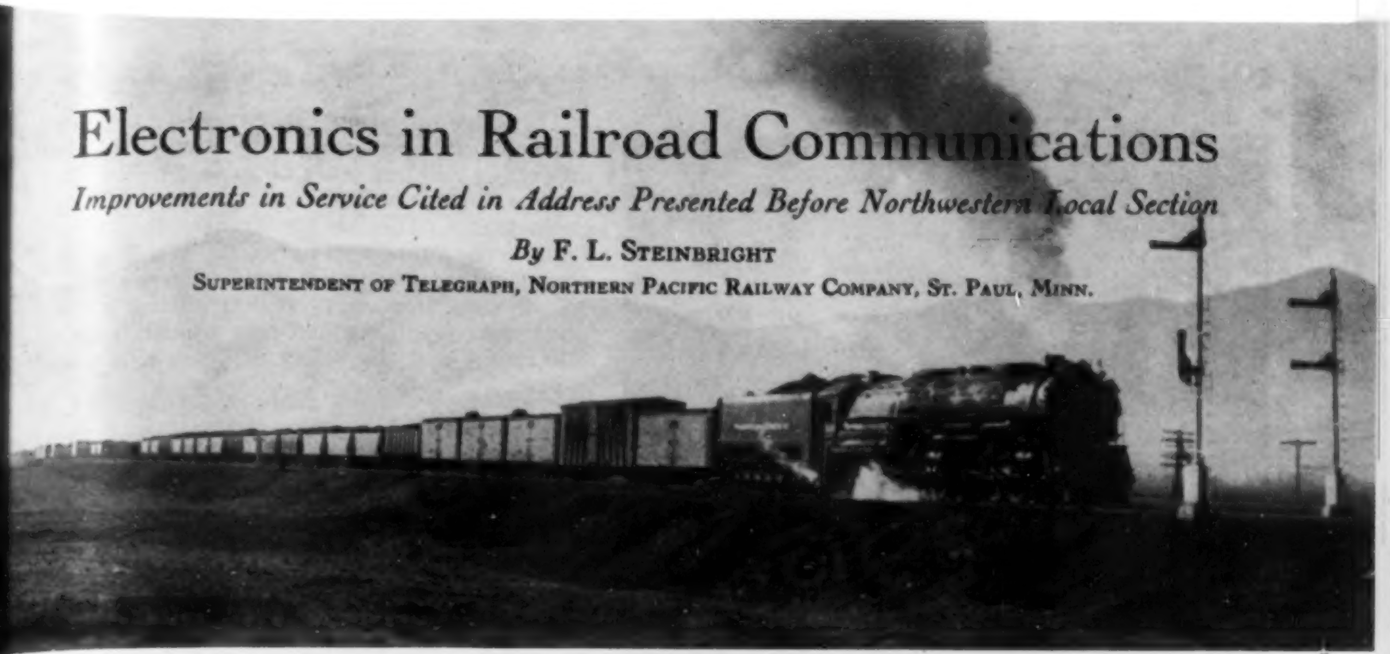
Employment of the landing mats in every theater of operations has won praise and acclaim from the highest command down to the ranks. For example, General Arnold, Commanding General, Army Air Forces, in his annual report stated: "The portable steel landing mat, used in all theaters, has been one of the outstanding developments of the war. . . . Portable steel landing mats have proved to be worth many times their cost."

Electronics in Railroad Communications

Improvements in Service Cited in Address Presented Before Northwestern Local Section

By F. L. Steinbright

Superintendent of Telegraph, Northern Pacific Railway Company, St. Paul, Minn.



Operation of Long Freights Can Be Speeded Up by "End-to-End" Radio Communication

Before considering some of the newer applications of electronics to railroad communications, it would be helpful to review the general nature of railroad communication facilities now in use. There are three general classifications of such facilities: (1) the dispatching circuits, which may be either Morse or telephone operated; (2) the local message circuits, usually confined to an operating division, which connect the division headquarters with virtually all stations and offices within its territory, and these also may be either Morse or telephone; and (3) the overhead circuits or long-distance services, which tie together the division offices and the general offices to unify the railroad system. In some railroads today it is possible to carry on a telephone conversation between any two stations or offices in the entire system.

The printing telegraph—or teletype—was the last major development in railroad communications to find wide application prior to the war. Electronics, as adapted to railroad communications, arrived almost with the war, so to speak, and was very timely indeed. When additional circuits were needed to handle a war load, and copper and iron wire were scarce, many railroads turned to an electronic system known as "carrier" (an unfortunate name for a system of communication when the railroads themselves are so often spoken of as carriers). By the use of "carrier currents" communication facilities on wire can be greatly expanded without the necessity of constructing more wire lines.

WHAT A CARRIER CURRENT IS

A carrier circuit might be considered as radio confined to wires. Separate transmitting paths are established on different electrical frequencies at the transmitting end of a carrier circuit, and at the receiving end these frequencies are sorted by means of electrical filters. It is the same as if several radio receiving sets were set up together and each one were tuned to a different station. That is what is done by carrier systems. A type of carrier system that is being used widely by the railroads provides two telephone circuits and anywhere up to a dozen telegraph circuits, and this system operates on the same pair of wires that is already carrying one telephone and one telegraph circuit.

On the Northern Pacific a carrier system of this type was placed in service between Seattle and Spokane early in 1944, and equipment will be installed by July 1945 to connect Spokane and Saint Paul. The completed carrier system will fill a pressing wartime need for long-distance telephone communication over the entire main line and will also provide necessary high-class long-distance telegraph facilities.

RADIO TELEPHONE

In recent months much has been written and spoken about the use of electronics to provide communication with moving trains. It appears evident that there will be many interesting applications in this field immediately after the war, and perhaps sooner. For example, the running time of main-line freight trains might be appreciably reduced by communication between locomotive and caboose, and between train and wayside station. That

Two-Way Hand Radio Set in Cab Puts Engineer in Contact with Conductor

YARDMASTER GIVING INSTRUCTIONS TO SWITCH ENGINE CREW OVER RADIO TELEPHONE

Radio Communication System Was Recently Installed by Rock Island Lines in Blue Island Freight Yard

is just one indication of the benefits that might be obtained from the application of electronics to train communication.

It should be mentioned that there are two systems of train communication being developed at the present time. One is what might be called pure radio, and the other is known as inductive radio or inductive carrier. The apparatus used for both systems is quite similar in appearance. Under the inductive system, energy from a transmitter on the caboose is radiated to the telegraph and telephone wires paralleling the tracks, travels along these wires, and again radiates across the gap from the wires to the locomotive, where the energy is picked up and amplified. Whether an inductive system or a pure radio system is used, the purpose and the results are the same, so it is convenient to refer to either by the shorter term of radio.

Communication from locomotive to caboose, or "end-to-end" communication as it is frequently termed, and communication from a train to a fixed point, have many projected uses. Here are some of the situations in which freight movements would be considerably benefited. Minutes could be saved in checking the air before a train pulls out. When passing "slow-order" territory the conductor or brakeman on the caboose could notify the engineer immediately when the entire train had passed the danger spot and it was safe to speed up. Much time is now lost pulling into and out of sidings because the engineer cannot tell definitely where his rear end is, and this lost time is subject to considerable reduction. Cross-over movements and back-up movements would also be speeded up.

One of the most important uses of radio on freight trains would be to notify the engineer when it is necessary to make an emergency stop for any reason. Without radio the conductor or brakeman on the caboose first must try to get the engineer's attention by hand signals and, failing this, he must resort to "pulling the air" at the rear end of the train. This has the effect of applying the brakes progressively from the rear of the train forward and not infrequently results in breaking the train apart at some point. How simple it would be by the use of radio to tell the engineer to do the braking and bring the train to a stop!

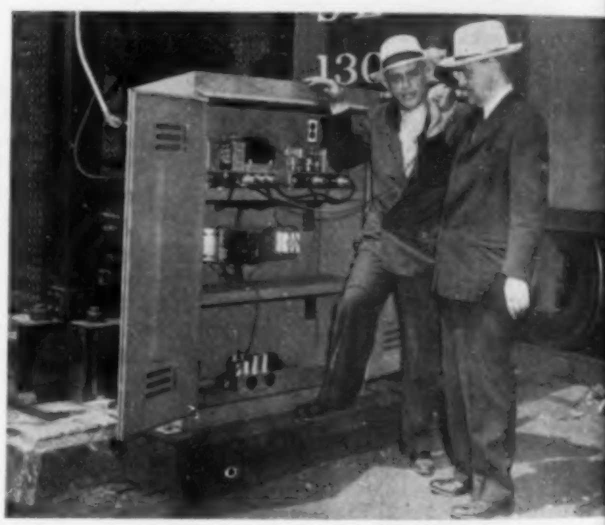
There are numerous other uses of radio between th head end and the rear end, such as in comparing tra orders, in case an order is missed by one end or th other when it is handed up; on steep grades with help engines, etc. There is good reason to believe that th time saving will be very material. It is presumed that equipment on locomotives and cabooses would opera on the same frequency, so that all trains within a fe miles of each other would hear what is going on withi this range, and the safety of operations would be en hanced.

OTHER USES

There is no reason why a flagman cannot have a walki talkie weighing 10 lb or less which would be useful possib from a safety standpoint and also from the standpoint saving time when the flagman goes out to protect th rear of the train.

So much for main-line operations. Of equal or great importance is the possible use of radio in yards an terminals. The average freight car spends almost much time sitting in yards as it does traveling over th road. If the switching can be speeded up by the use radio between switch engines and the yardmaster, th effect will be to shorten the overall time required fo freight movement. There is a big field here which is be ing covered to some extent currently by the installatio of two-way loudspeaker communication systems at fixe points around yards, but there are no doubt many yard where radio will accomplish considerably more than th loudspeaker arrangement, which has limitations.

The use of radio in industrial switching areas give great promise. It may sound amusing but locomotive do get lost in some of our larger cities. It is evident tha



CENTRAL CONTROL STATION IN BLUE ISLAND YARD OF ROC ISLAND LINES BROADCASTS TO LOCOMOTIVES IN YARD

if constant contact could be maintained between central point and the numerous switch engines workin around an industrial area, the pickup and delivery of car would be greatly facilitated. If derricks, snow plows and other emergency apparatus were equipped wit radio, emergency work would be speeded accordingly.

There are many who believe that when the first large scale installations of radio are made, the benefits will sur prise even those who have been in a position to study th possibilities. The railroads of America have alread asked the Federal Communications Commission fo something like 150 wave-length assignments for use i train communication.

Will New York's Industries Expand?

Economic Study of This Metropolitan Area, Presented at Annual Meeting of City Planning Division

By Homer Hoyt

Director of Economic Studies, Regional Plan Association, Inc., New York, N.Y.

As a result of new technical inventions and the opening up of a virgin continent with its vast resources, our cities grew with amazing rapidity in the first century and a third of our existence as a nation. From 1790 to 1930, the population of places of 2,500 and over increased from 200,000 to 69,000,000. The average rate of growth of all places of 8,000 and over was 51% per decade. As for New York, it grew from 49,000 to nearly seven million in this period and the New York Metropolitan Region increased from 231,000 to 11,500,000.

This type of growth led to the method of estimating future urban population by projecting past trends—a method always risky and now extremely hazardous. For since 1930, the long-range curve of urban growth seems to have leveled off. In the decade 1930–1940 American cities increased only 7.6% in population. Present birth and death rates and very limited immigration lead to an even lower estimate for the future—only 5% per decade.

It is now a question not of how fast our cities will grow, but of whether they will grow at all. Hence it is more important than ever to analyze the economic background for a particular city in order to determine future growth. This brings us to the specific question as to what factors can be expected to operate in the case of the New York Metropolitan Region.

New York is usually regarded as a great financial, commercial, and shipping center, which it is. On its stock market are sold 90% of all the shares traded in the United States. Its bank debits to individual accounts over a long period of time have been greater than the bank debits of the next 140 largest cities in the United States combined. Through its port come one-half of all the imports and exports, by value, of the entire Nation. Its life insurance companies hold 57% of the insurance assets of the country. In addition, it has the greatest amusement center, with most of the country's legitimate theaters.

Notwithstanding its paramount position in these fields, manufacturing is the basic support of more people in New York than any other factor. There are over 36,000 separate industrial firms in the New York Metropolitan Region employing 1,400,000 workers in 1940 and over 1,800,000 in 1945. There are over 312 separate industries, of which apparel, with its numerous subdivisions, accounts for about one-fourth of the total factory employment in peace times. We produce here everything from buttons to battleships. Three-quarters of our total factory employment is engaged in the manufacture of non-durable goods, like food and clothing, petroleum, rubber and paper products.

The total importance of manufacturing is not measured by the number of workers in the factories alone, for directly or indirectly factory workers support a large number of others in the retail trades and in the professions. In measuring the economic background of a city, the decisive factor is the opportunity for employment in producing goods and services for people living outside the city or the urban region. Any city, by the very definition, cannot be self-sufficient. It cannot raise its own food or raw materials for clothing, or produce all the manufactured goods it requires. Hence, it must produce a surplus of goods and services which it can exchange for the food and raw materials which it lacks. In the New York Region in 1940 there were a total of 1,500,000 workers in such employment, of which 900,000 were producing manufactured goods in excess of local needs for shipment outside the region. This total of 1,500,000 employed persons supported 3,245,000 other persons who were engaged in local manufacturing, local transportation and utilities, retail trade and the professions, personal services, trade, construction, and local government.

PROSPECTS FOR GROWTH

Such being the importance of manufacturing in New York, what are the prospects for its growth? Some reports have been issued indicating that it is declining in importance as a manufacturing center. These reports have been due in part to comparing New York City, which is the central part of the New York Metropolitan Region, with metropolitan regions or larger areas. All central cities have been declining as their suburbs grow because there has been a movement of industries from the center toward the outer edges of metropolitan areas. Comparing the trend of manufacturing employment in the New York Industrial Area, consisting of six counties in Northeastern New Jersey and Westchester County as well as New York City, with that in other similar areas, New York took the lead from 1929 to 1939.

It is true that greater gains were made among the smaller cities of the South Atlantic States, North Carolina, South Carolina, Maryland, Virginia, and Georgia, than in most of the larger metropolitan areas. In the entire United States, manufacturing employment has failed to keep pace with the growth of population since 1919 because of the constant improvement in the technical efficiency of labor. As Solomon Fabricant shows (*Employment in Manufacturing, 1899–1939*, National Bureau of Economic Research, New York, 1942, page 10), the physical output of manufactured goods was quadrupled between 1899 and 1937, while the number of factory workers was only doubled. Thus in 1919 there were 8,424,000 factory wage earners, a peak which was exceeded only slightly in 1937, when there were 8,569,000 factory workers employed. In all other peak years prior to World War II, the manufacturing employment was below the level of 1919. It took the war to raise the number of factory wage earners in the Nation to the all-time peak of 14 million in August 1943.

GROWTH OF COASTAL CITIES

A phenomenal growth of employment in airplane plants and shipping in San Diego, Los Angeles, San Francisco, Portland, and Seattle was caused by the huge war orders placed there. A tremendous increase in the war population in those areas accompanied this growth. San Diego has doubled its population since 1940. While the growth of factory employment during the war in these areas and also in Baltimore and many other war centers

in the South, has outstripped that of New York, this city after a late start rose to 72% above pre-war levels, which is above the average rate of gain for the United States. However war employment in New York only absorbed the idle manpower. It did not attract a great amount of in-migration. Hence New York is not faced with the problem of providing for a large number of migrants who will be left without jobs when airplane and shipbuilding industries contract.

Rapid growth of industry during and prior to World War II on the Pacific Coast and in some regions of the South has aroused speculations as to the manufacturing future of New York. What are the prospects for the growth of employment in the factories of the region? Will the Pacific Coast area or other regions draw trade and industry from New York?

ADVANTAGES OF LOCATION

In analyzing this situation, the location of the great resources and markets of the United States with reference to New York must be considered. New York City is at the center of the greatest mass of purchasing power and income in the world. Within a 50-mile radius of Times Square there are 12,500,000 persons; within 250 miles there are 32,500,000; within 500 miles there are 52,700,-000; and within 750 mile sthere are 76 million persons. A radius of 1,250 miles from New York would take in a total population of 108 million persons, or 82% of the population of the United States. This would likewise include over 82% of the national wealth, practically all our high-grade iron and coal deposits, and a high proportion of our best agricultural land.

Within a similar 1,250-mile radius of Los Angeles, there are only 20 million persons, or 15% of the population of the United States. With reference to the huge population and purchasing power of its trading area, New York is in a strategic position. It is located at the gateway to the sea-level route along the Hudson River, the Mohawk Pass, the route of the Erie Canal to the great industrial center and agricultural resources of the Lake States. Also it is at the center of a great belt of coastal cities, stretching from Boston to Washington, which are linked together by water transportation.

HUB OF THE RICHEST MARKET

Manufacturers of the New York Region thus stand at the center of gravity of the richest market in the world. They have the benefit of the lowest freight rates in the United States because the heavy concentration of traffic and the availability of water transportation warrant them. They have access to raw materials brought from Europe, South America, Africa, and even the Orient by cheap water transportation, and they are located within close proximity of the richest raw materials and resources of the United States.

It would seem therefore incredible that manufacturing would make a major shift in the postwar period from the areas containing these great stores of natural resources and these great consuming markets to thinly populated sections in the West which are lacking in many of the resources found here. It is true that the relatively recent rapid growth of Los Angeles has created an expanded market for supplying local manufactured goods, but this upward trend will reach its limits when the local population is satisfied. The hinterland of Los Angeles contains great desert areas and thinly populated regions which do not offer the markets for manufactured goods which the densely populated hinterland of New York does.

The New York Region thus possesses the advantages of an unrivaled position at the center of transportation routes leading to the richest resources and markets of the country, but these advantages do not insure its continuous growth. There are also serious disadvantages. It has already attained a great size as a result of these natural advantages. It is more difficult to maintain a huge population of 12,500,000 which has already exploited the opportunities before it than it is to maintain a population of two million in an area that is being developed for the first time. Moreover, the very great advantages of New York's site have led to a higher standard of living than obtains in the Nation as a whole, and the highest cost of municipal services, which have tended to increase overhead costs of doing business and also labor rates. The congestion of a large population has likewise increased costs by the friction of traffic congestion in central areas, by the cost of subways and express highways to transport so great a population from places of work to residences, and by the extra expense of going great distances to secure an adequate water supply. In addition, in a city which has long enjoyed such great natural advantages, it was possible to succeed, even with some relatively inefficient methods on the part of labor and capital. In so rich a market, high charges could be levied for certain services, make-work policies could be adopted, and still the market would bear the burden.

As cities grow older, traditional and customary practices which tend to impair efficiency become embedded in their economic structure. Furthermore, because New York reaped such extraordinary gains as a result of its natural position, almost without any promotional effort on the part of its leaders, it became natural to suppose that business would naturally gravitate to New York in the future as it had in the past. Therefore, New York has been at a recent disadvantage compared with younger cities which have exerted great efforts to secure new business enterprises, and which have frequently succeeded in obtaining them simply because they went out to get them. These obstacles in the way of the future growth of manufacturing in the New York region, however, are chiefly man-made and can be removed by abolishing obsolete customs and practices and by a new and energetic approach to the region's industrial problems. At this point, the planning of new and more efficient industrial districts in central areas, and the more balanced development of central and suburban residential growth, will contribute greatly to making New York a more efficient place in which to work and live.

NEW INDUSTRIES ESSENTIAL

To supplement old established industries, some of which may be declining because of the improvement of technical efficiencies which may replace workers, it is necessary to find new and rapidly growing industries such as electronics, plastics, and prefabricated housing. These industries starting from scratch will represent a needed addition to employment, which will serve to take up the slack created by increased technical efficiencies or by the decline of old industries. In planning for the future, a rapid growth is not necessary for economic health. It is desirable, however, to avoid actual decline in population and purchasing power because that would mean falling values, which would have a dampening effect upon programs for the redevelopment of the city.

If this slower mature growth can be achieved, and if the incomes of the great mass of the people can be maintained, it will be possible to finance on an economic basis most of the clearance of blighted areas and the gradual transformation of the city into a more efficient physical mechanism and a better place in which to live.

In at the Start at Panama

III. When a Division Engineer Was All Things to All Men

By the late FRANK B. MALTBY, M. AM. SOC. C.E.

EARLY DIVISION ENGINEER AND, FOR SIX WEEKS, ACTING CHIEF ENGINEER OF THE CANAL

THOSE engineers who knew the Canal work at its peak, when all details had been organized to perfection, will hardly recognize this picture of the early days. A division engineer like Maltby then had to be able to play a variety of roles. There was never a tiresome moment. One day it was a mammoth ocean-going suction dredge to be designed. Again a foreign visitor or a Congressional emissary, such as Secretary Taft, was to be convoyed about. In between, a flying trip to the States resulted in the creation of a complete bakery. Over all the spirit of John F. Stevens brooded. This third installment of the series makes a fascinating tale, as seen through Maltby's eyes.

IN the early days at Panama we had to design sea-going dredges. The general idea of their construction was not new; dredges of this type had been built and operated before. However, the details leading to increased efficiency and adaptation to conditions at Panama were all worked out in our drafting room in Cristobal. I had had some experience, not at all satisfactory, in building dredges according to general specifications. These called for a type, gave a general description, and required a guarantee of performance. The details were then left to the builder.

Because they were to be built by ship builders and not dredge builders, and because of the inherent disadvantages of general specifications, our dredges were designed in detail in every respect, the specifications covering over 200 printed, pamphlet-sized pages. They were first of all steamships, with the usual equipment of boilers, propelling machinery, and accessories. One was built for the Atlantic terminus and one for the Pacific. The one for the Pacific went around the Horn under her own steam and carried in her hoppers enough coal to La Boca to pay for the trip. During its first month of operation, this dredge broke the world's record for monthly output for its type.

While I was designing these dredges, a question arose in my mind regarding a detail. After some study I decided to go over and ask Mr. Stevens for a decision. He listened patiently to my rather long-winded presentation of the problem, while keeping still in all the languages for which he was famous. I finished, out of breath, and looked at him for a reply. He leaned back and looked at me, and the only remark he made on the subject was, "Maltby, what in hell do I pay you for?" The argument was over—I couldn't "pass the buck."

On the other hand, he would back up a man to the limit. For example, when the plans and specifications for these dredges were completed, they were sent to Washington with a requisition for purchase. Washington, without advising us, made some changes in the specifications and advertised for bids.

When the bids were received, all papers were sent to the Isthmus for recommendation as to the award of the contract; of course they came to me for comment. After examining them I took them to Mr. Stevens and said, "They have changed the specifications somewhat; maybe they are better than mine. But you cannot change specifications of this kind by changing a paragraph here and there without going all through the 200 pages and changing any and all parts having any bearing on the changed paragraphs; and this they have not done. I don't know what we will get."

He promptly called a stenographer and cabled Washington, "We deny all responsibility for dredges built under your plans and specifications." Immediately bids were canceled, readvertisements were issued under the original specifications, and the dredges were built under them.

The failure of the French in the matter of sanitation has been variously ascribed to climate, graft, and incompetency. Climate is usually understood to mean the diseases commonly supposed to exist in a tropical country where they have not been controlled. Undoubtedly a part of the failure was due to these causes.

In a cemetery known as "Monkey Hill," a short distance from Cristobal, it was said that 66,000 persons were buried during the construction of the Panama Railroad and of the Canal under the French régime. And no one knows how many thousands were buried along the line between Colon and Panama City. The tremendous death rate was due in large measure to ignorance of the causes, to a fatalistic idea that the conditions were inherent in the tropics and could not be avoided, and to the indifference of the employers to the fate of their men.

As far as temperature and weather conditions are concerned, the climate in Panama is delightful, though to some people brought up in northern latitudes it may prove enervating after along residence. In Colon the temperature runs at about 85 deg—I don't know that I ever saw it above 90. It is 85 the year round, with the only seasonal change from wet to dry and vice versa. There are no violent changes, no blizzards or heat waves, and no violent storms.

During the rainy season, when it rains it just rains down in torrents for a short time. There is little wind during these showers, and almost no thunder or lightning. However, we did have a tug struck by lightning once, and

JOHN F. STEVENS AS PANAMA KNEW HIM
At Work in His Office at Culebra

LOOKING EAST ACROSS PANAMA BAY FROM ANCON HILL, WHERE THE SUN RISES OVER THE PACIFIC

View Taken About 1906, Shows Governor's Residence in Foreground, Under Construction; Main Part of Panama City Is Out of View at Right

of course one notices the exceptions. It may rain several times a day. Then the sun comes out between showers, and at such times it may become rather sultry. People generally prefer the Pacific side because there is less rainfall. And that's the climate.

Of course such a climate would assist in the propagation and growth of any disease once started, as it also assists in the prolific growth of everything in the vegetable kingdom. When the U.S. Government assumed control, practically none of the methods ordinarily used for the protection of health were in force. There was no adequate water supply either in quantity or quality, no sewer systems, and no provisions for the intelligent disposition of human waste. The conditions arising from this lack were terrible. The warm and moist air made the decay of vegetable or animal matter very rapid, and the whole Isthmus was indescribably filthy from end to end. Mosquitoes existed in swarms; hygienic methods and practices were unknown.

ALL CREDIT TO COLONEL GORGAS

Ships from all parts of the world called at the ports of Panama, and their cargoes and passengers were transported across the Isthmus, giving the opportunity of introducing diseases from distant places. As a consequence many diseases existed, the most prevalent being the so-called Chagres fever—a malignant form of malaria—and the dreaded yellow fever. The fear of the latter was due largely to ignorance as to its cause and successful treatment.

To exterminate mosquitoes at Panama a most drastic program for destroying their breeding places was inaugurated. Underbrush and dense vegetation were cleared off the territory surrounding any work or habitation for a distance of 1,000 ft. It was found that a mosquito would not fly farther unless blown by the wind.

Standing water was thoroughly drained or covered with oil. Any receptacles that might catch and retain water were removed—or screened. Rubbish piles were cleaned up, as they might contain something that would hold water. An empty tin can was the special aversion of the Sanitary Squad. We became so clean, orderly, and "dried out" that it was painful; but the mosquito disappeared. (It was rumored that salt was put in the holy water in the churches to discourage the pests, but I cannot vouch for that.)

A storm of protests arose over the rumor that the Royal Palms at Ancon were to be cut down as the branches or leaves held water. This was not done and I do not know that it was contemplated, but it illustrates the extreme thoroughness of the sanitary work.

All was under the direction of Col. W. C. Gorgas of the Medical Corps, U.S.A., head of the Medical and Sanitary Division. Through his knowledge, devotion, and untiring energy, his efforts were entirely successful. He it was who made the building of the Canal possible. He was a perfect gentleman, with a most charming personality and kind disposition.

I had one good joke on the Colonel of which I enjoyed reminding him—even when he was a major general. A warship of the U.S. Navy came into Limon Bay and remained several days. Colonel Gorgas and his assistant, Major Pierce, wished to pay their respects. As I had the only launch in the harbor, in fact the only boat suitable for the dignity of a Colonel in the U.S. Army, I was very glad to offer to take them out to the ship. We climbed the companion ladder and were met by an orderly.

After the Colonel had stated his business, the orderly roared in a voice that could be heard all over the ship (and I think ashore), "Two officers and one gentleman are calling on the Commanding Officer."

I START A BAKERY AND BECOME CHIEF ENGINEER

Frequently Mr. Stevens made trips of inspection along the line, and to Colon, but never in a special train. He could usually be found in the baggage car or on the back platform. His trips were seldom announced—not because he was looking for something that might not have been reported, or spying, but because he hated notoriety and disliked having any fuss made over him.

One day he strolled into my office on one of those unannounced trips, sat down, lighted a cigar, put his feet

ISTHMIAN ALLIGATOR HUNT YIELDED A GOOD HAUL FROM THE CHEPO RIVER

up on the desk and said, "Maltby, what do you know about a bakery?"

"Not a damned thing."

"Well, you can find out, can't you?"

"Yes, sir."

"Well," he said, "I want to bake 10,000 loaves of bread a day."

"I suppose you mean yesterday."

"Yep."

"I am going to the States tomorrow," I said.

Those remarks constituted the sole and total instructions ever received on that project—talk about a man of few words! I visited many bakeries and learned what machinery and equipment were used and decided on the best for our purpose. Through the Panama Railroad machinery and equipment were then purchased, as well as material for a building. Now by this time I had begun to know the Chief pretty well, and I got back at him when he asked how I was getting along on the bakery by replying "All right," and nothing more.

Soon after this the earthquake at Kingston, Jamaica occurred. A relief ship, which was loaded at Colon and sent to the distressed city, contained among other things 10,000 loaves of bread from the new bakery.

At another time Mr. Stevens made one of his informal [...]s at my office and announced in his casual way, "I [...] going to the States tomorrow on a short vacation and [...]nt you to play Chief Engineer while I am gone."

"All right, but I will probably get fired when you get [...]k."

"No," he said, "you won't get fired if you do something, [...] you will if you don't do anything. Do something [...]n if it is wrong, for you can correct that, but there is [...]way to correct nothing." (Incidentally, mighty good [...]vice that could be applied anywhere—it is largely [...]ough our mistakes that we learn and progress.)

Fortunately there was no crisis and no critical situation [...]se. I did not have to make a "momentous decision" [...]d the Canal was all there when he came back. I did, [...]wever, have the honor of acting as chief engineer of the [...]nama Canal for about six weeks.

We had a saying for the mystification of our families [...]d friends from the north—"This is a great country [...]ere (1) the west end of the Canal is east of the east [...]d; (2) the sun rises in the Pacific Ocean; and (3) [...]sters grow on trees." One time I told this to a Lord [...]d Lady Cork of England, who had arrived as tourists [...] a Royal Mail Line ship.

"What do you mean?" he replied. "The idea is pre[...]sterous!" So I demonstrated two of the points.

First I explained what most people thought, that to go [...]m the Atlantic to the Pacific one necessarily must go [...]m east to west. It so happens, however, that the [...]hmus runs in the general direction of west to east; [...]d the Canal in the general direction of north to south, [...]t bearing enough to the east so that the west or Pacific [...]d is east of the Atlantic or east end.

Second—I showed how on the Pacific side Panama Bay [...]ents the Isthmus to such an extent that at Panama [...]y the sun rises in the Pacific Ocean. (I once wakened [...]s. Maltby to demonstrate this fact, much to her [...]gust.)

"If you will take a little trip in a launch with me after [...]ch," I said, "I will demonstrate the third point."

"Delighted. And will we see some crocodiles?"

"I have no control over them," I replied. "Crocodiles [...]long to the Panama Railroad." I don't know whether [...]y ever understood that joke.

So I took them around the harbor and finally, much to [...]eir amazement, entered what appeared to be a long [...]rrow lake, buried in the jungle—the old channel back [...] Colon Island. It was the quickest and certainly the [...]st comfortable way of getting into the heart of a [...]pical jungle that I know of. No one lived within miles, [...]d it was not near any line of communication. You [...]ow, a mile in a tropical jungle is as good, or as bad, as [...] miles on the prairies, and you can get solitude in [...]unks of any size desired. It was a beautiful place and [...]y guests were thrilled and carried away by the unusual [...]auty.

"Now notice," I said, "the mangrove bushes growing [...]ht down to the water's edge. Their branches bend [...]er and down into the water and they are covered with

Native Produce Boats, Scene of Open-Air Market at Panama Bay in Early Days of the Canal

oysters or some kind of shell fish. There you see oysters growing on trees."

We moved along slowly, the engine on the launch making very little noise. On a little grassy bank eighteen inches or two feet above the water lay a crocodile about fourteen feet long, asleep in the sun. We edged in, and as the wind was favorable, got within fifty or sixty feet of him, or as close as I dared go for fear that he might strike the boat when he went into the water. The fireman woke him up with a chunk of coal, and without a sound he came up and forward on his four legs and into the water head first with hardly a splash.

Everyone had been breathless. It was the largest crocodile I have ever seen close by. There were a great many very large ones in the head of Limon Bay, but we could never get within several hundred yards of them.

Division Headquarters Moved to Gatun

As soon as the building program at Gatun had advanced to the point where sufficient buildings were available, the headquarters of the Atlantic Division was moved to the new quarters there. In fact, in order to begin excavating promptly, I think we moved while some quarters were still in tents.

After a very careful study of the detailed topographical map and the borings, the center line of the lock was located and approved by Mr. Stevens. I understand that this line was subsequently moved all over the hill by the engineers who followed, but the locks actually were built 10 ft south of my location.

In this connection it should be remembered that Mr. Stevens delegated wide authority to the Division Engineers and held them responsible for the results. This does not mean that important questions such as the location of a lock or dam, methods of construction, or special equipment were settled without his approval. He did, however, expect the engineers to take the initiative and make recommendations.

After my experience with him as to a detail on the design of the sea-going dredges, I did not bother him with details very often. Excavation for the lock at Gatun was started using the same method and plant as in the Culebra division, steam shovels loading onto cars and disposal of the material to the best advantage.

Even before the type of canal had been determined, I sent survey parties out to locate on the ground, and map the location of, the 85-ft contour around what was to become Gatun Lake. There were eventually five of these parties, and they were instructed to carry their observations up to 100 ft along the hills towards the Atlantic or any other ridge where there was a possibility of a saddle lower than El. 85.

These surveys were practically all made in a dense jungle. Even to walk through it required a lot of cutting.

Town of Cruces on Upper Chagres River, One of the Largest of Its Type in the Canal Zone

NATIVE OX CART, BUT WITH BETTER WHEELS THAN USUAL
Note Mode of Harnessing, by the Horns; Goad Stick Left in Front Serves to Hold Team Stationary

To get any instrumental line of sight and measurement required cutting and clearing nearly every foot of the way. Progress was very slow.

Each party consisted of five or six white men, with the necessary colored labor. All supplies were packed in from the nearest village or stream that would float a dugout. The parties were given everything possible to make them comfortable. The men were remarkably healthy, happy, and contented and seldom wanted to come into headquarters. Some of them stayed out nearly a year, and I believe that one man was out more than a year at one stretch. I finally sent out word that all must come in for a Christmas party in Cristobal.

They were in frequent touch with headquarters by runners and thus received their mail regularly. There were no wild animals to fear and very few snakes. They did not suffer from mosquitoes as much as the rest of us did. But even so they were the only bunch of surveyors I ever saw who did not want to go to town as often as they were allowed to.

INSPECTORS HAVE TROUBLES

All large enterprises seem to have more or less trouble in connection with timekeeping and payrolls. At the start I had some colored timekeepers from Martinique who were very industrious, clannish, and quiet. They may not have been more honest than others, but neither I nor any one from our financial office ever discovered any crookedness. Their payrolls were always neat, accurate as far as calculations went, and out on time.

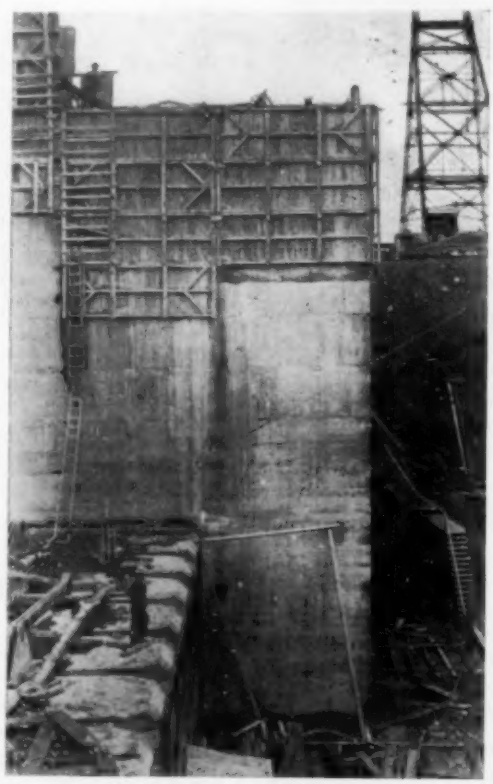
The Financial Department then decided to abolish timekeepers. Instead they would let the foremen keep the time of each gang and have their time inspectors check each day. I said, "No, I will keep my timekeepers for I never knew a man who was a good foreman that was worth anything as a clerk. You put on your inspectors and check all you want to."

Then the fun began. First one inspector wanted to know, "How about the time of these survey parties?" I said, "I suppose you will have to go up there and see them if you certify to the payrolls. I will give you a runner to show you the way but it will be some job for you." This settled that inspection!

After the inspectors had made a few reports to their departments of shortages of men on different gangs—all cases in which I was able to show very promptly that the men were on the job—they became rather leery about reporting such shortages and came to me first. One day one of them came in very much disturbed and said that he could not find ten men supposed to be working at the Cristobal drydock and machine shop. "Well they are there," I said, "and it is up to you to find them." Relenting, I added, "I happen to know that they are cleaning out the double bottom of one of those dredges. It is up to you to crawl in there and check them, or else to sit and watch the hatch like a cat till they come out."

TAFT INSPECTS

The question of the adequacy of the foundations for the Gatun locks had raised so much argument that the President appointed a Board of three engineers to come to the Isthmus, examine the site, and report their recommendations. They were accompanied by the then Secretary of War, William Howard Taft, and two Congressmen. In the meantime, in addition to hundreds of core drill borings, I had dug a lot of test pits. The excavated material was removed by loading into large steel buckets, which were hoisted to the surface with an old-fashioned windlass, made of the trunk of a tree 6 or 8 in. in diameter, properly supported across the pit, and with a substantial crank at each end.



GATUN LOCKS, WITH BEARING SILL FOR EMERGENCY DAM GATES IN FOREGROUND
Upper Right, One of Cableway Towers Erected by Maltby

One day in response to instructions, I met Mr. Taft and his Congressmen at Gatun. He rolled off the back platform of the train with "Hello, Maltby, how are you getting along?" He went over into the shade of a big mango tree, climbed a pile of ties, and began a story. It was nice and cool there in the shade.

Finally he said, "Well, I suppose I have got to look at what you have to show me." I asked if he wanted to go down into one of the test pits so he could report that he had personally examined the foundations. One Congressman said, "I think this is one time when we should insist on official precedence; the Secretary should go first." Mr. Taft pulled off his coat, stepped into the bucket, and was slowly lowered by four big laborers down into the hole for 20 ft or more. I was mighty glad to get him out of there. He was a big man and the rope on the windlass looked awfully small just then. The Congressmen, of course, had to repeat the experience, but I was not worried about them.

Site Planning of Cantonment and Community Housing

By Leon Zach, M. Am Soc. C.E.

Chief, Site Planning Section, Military Construction Branch, Engineering and Development Division, Office, Chief of Engineers, Washington, D.C.

HOUSING at military installations has to be planned as an integral part of the whole installation just as residential areas of a city must take their proper place in the total city plan. Housing areas of a cantonment are "zoned" for officers, troops, and WAC's. The industrial area of the normal city plan becomes, in the divisional cantonment, the "warehouse-utility area" with its railroad yards, warehouses, laundry, bakery, and clothing and equipment repair shops. The division's "civic center" includes its town hall (the Administration Building), its bank (the Finance Office), its post office, shops (Post Exchange), and theater. In this article, Mr. Zach indicates the numerous factors that must be evaluated in successfully planning a housing area for a military establishment or a war housing development for civilian workers.

IN much the same manner as the city planner, when he first attacks a new problem, must be ld early in the game (or learn by tensive physical and economic rveys) the needs and requirements of the city, so the first step in reparing site plans for Army installations was to learn in detail the equirements of the "clients," the sing services—Army Ground Forces, Army Air Forces, the Surgeon General, the Provost Marshal General, and others. Tables of rganization provided adequate data n (1) the size of various complements—infantry, artillery, medical, ngineer, quartermaster, etc.; (2) he number of men to be housed in roups—companies, battalions, and egiments; and (3) the number of ehicles they use, which on a standard allotment of space per vehicle 50 sq yd) gave the area to be set aside for motor storage r each organization. Close liaison with appropriate uthorities among the using services produced much dditional practical information. For example, it was oon learned from Army Ground Forces that economy f training time necessitated the location of the cantonment within a half-hour's marching distance of the small-rms range; from the Surgeon General, that efficiency n the operation of hospitals required a maximum pitch f 3% in the corridors connecting clinics and wards; om the Provost Marshal General that security measures emanded special fence construction and lighting, and so orth.

Satisfying the needs of the using services and at the ame time assuring speedy and economical construction, equired the development of typical layout plans which how the most comprehensive arrangement of structures ossible and give complete coordination of the various unctional areas—such as housing, utility areas, storage reas, and hospital area. The spacing of buildings, or the sake of economy, was kept as small as possible hile still providing safety from a fire-prevention viewpoint and adequacy of air and ventilation. Reduction f fire hazard was attained by applying standard minimum allowable spaces between buildings of different eights and types of construction and by providing firebreaks approximately every 1,000 ft of built-up area. Widths of firebreaks were 250 ft for mobilization-type evelopments and 150 ft for theater-of-operations type evelopments.

Accompanying the typical layouts, the written directions of the Engineering Manual of the Corps of Engineers required special consideration of the circulation f vehicular traffic between one area of intensive use nd another, and called for an overall design that would void cross traffic. To avoid traffic congestion and confusion, the following general principles applied:

From public ways to cantonment, access was required to be by not less than two main roads, one leading to the general housing area proper, the other giving direct access to the warehouse-utility area without interference from traffic to the housing area.

From warehouse-utility area to housing area, circulation should be free of obstructions, such as crossings with other roads, so far as practicable.

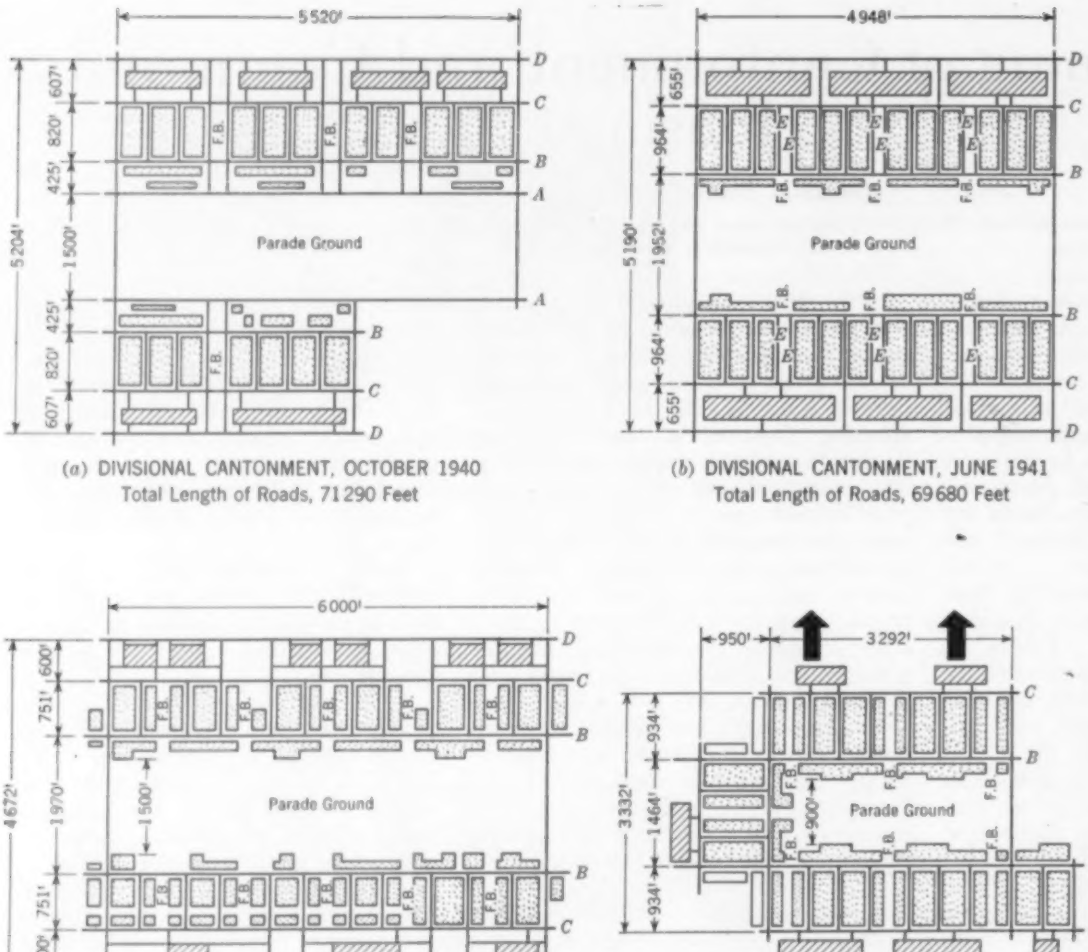
From housing area to station hospital, there should be one approach to the hospital administration building and a separate approach for supplies to the rear of the hospital area, where storehouses, laundry, and power plant are concentrated.

From cantonment to training areas, a sufficient number of exits should be supplied so that troops will spend a minimum amount of time in passing between the cantonment and training areas, and a maximum amount of time in training, the proper relationship between troop housing areas and training areas resulting from a scheme by which each regimental unit was so located that its troops would be free to pass to their training areas over their own roads without interference by other troops. Avoidance of the common use of one road by more than one major troop unit appeared to be the best assurance against traffic jams and serious loss of training time.

ADAPTING TYPICAL LAYOUT DIAGRAMS TO SPECIAL SITE CONDITIONS

The typical layout diagrams for use as a guide in the field were merely representations in compact diagrammatic form of a standard relationship of all the structures required by each military unit. As a precaution against the obvious danger of a too rigid adherence to, and too arbitrary use of, these diagrams, field agencies were instructed to adapt the diagrams to fit the wide variety of ground and water forms, soil types and conditions, and tree and ground cover to be found on specific sites. For example, extreme conditions of dust raised by the large number of tactical and other motor equipment, especially at armored division camps, would make it advisable in some cases to place regimental housing areas side by side in one line (rather than in two lines facing a parade ground or other open area) and to orient this line in such a relation to the prevailing winds that the dust would be carried away from the housing units. The hospital area of any cantonment could not be located to leeward of a potential dust area.

In the case of divisional layouts, infantry and armored, the typical layout diagrams included not only the cantonment proper, but also the camp site as a whole, in



(*a*) DIVISIONAL CANTONMENT, OCTOBER 1940
Total Length of Roads, 71290 Feet

(*b*) DIVISIONAL CANTONMENT, JUNE 1941
Total Length of Roads, 69680 Feet

(*c*) DIVISIONAL CANTONMENT, AUGUST 1941
Total Length of Roads, 65164 Feet

(*d*) DIVISIONAL CANTONMENT, MAY 1942
Total Length of Roads, 40140 Feet

FIG. 1. PROGRESSIVE IMPROVEMENTS IN DIVISIONAL CANTONMENT LAYOUTS

order to show the using service's requirements as to artillery and maneuver areas, small-arms ranges, and such, and to emphasize the importance of close relationship and easy accessibility between troop housing and these training aids. These plans were considered diagrammatic only, and again adaptation of the diagrams to any given camp site was obviously necessary either for purposes of economy of construction or maintenance, or to satisfy special military needs or unusual topographic conditions.

In the case of general hospitals, efficiency of operation, convenience of traffic between buildings, and need for a full measure of sunlight and air, demanded more rigid adherence to the typical layout diagrams than in the case of any other military unit, except possibly prisoner-of-war camps, where for security reasons—to facilitate the guarding of prisoners—it was necessary to follow standard practice closely. In both cases, as in all other layout planning, the requirements of the using services became the outstanding motivating factor in the site layout. Efficiency of operation, usefulness of the project for its particular phase of troop training, must of necessity take first place. A strong second place, however, was given to economy of construction, and every effort was continually made to consolidate functions and to compact areas to the utmost consistent with efficient use of the project. Increasing knowledge acquired by the constructing agency of the functions and needs of the using agency resulted in the improvements, from the standpoint of economy, that will be described.

The real estate promoter who built houses and sold properties on only one side of his streets would soon go bankrupt. On the basis of as simple an axiom as this, early economies in cantonment layout were effected. Old typical layouts were analyzed and intensive efforts to reduce the unused portions of roads and utilities to a minimum resulted in the progressive economies and improvements shown in the skeleton layouts of an infantry division cantonment in Figs. 1, (*a*) to (*d*) inclusive.

These diagrams show the housing of officers and enlisted men (stippled areas), the motor storage areas for tactical vehicles (crosshatched areas), and the parade ground of a typical infantry division. They omit only the warehouse-utility area and the post hospital, which could usually be isolated from the housing area. Figure 1 (*a*), indicating the typical layout inherited when the present emergency arose, shows the maximum of road net employed in the layout of an infantry (triangular) division proper—approximately 71,300 lin ft of road. The long roads (A, A) on each side of the parade ground served structures on only one side of the road and a not-very-high concentration of use on the other side. By a rearrangement of buildings in the blocks between Roads A, A and B, B it was possible to eliminate both A roads and still serve every structure with roads and utilities.

GREAT IMPROVEMENTS REALIZED THROUGH THE YEARS

The reduction in road length (2.3%) in this first move was minor in comparison with that shown by the second major change. This resulted in eliminating the large number of secondary roads E, E, of Fig. 1(*b*), on each side of firebreaks, which also served buildings on only one side of the road. The firebreaks (labeled "F.B." on the sketches) were relocated, as shown in Fig. 1(*c*), so as to occur within the blocks of housing rather than between blocks. This plan resulted in a saving in cantonment road network of nearly 9% over the original scheme.

Other factors influenced the still greater economy effected in layout shown in Fig. 1(*d*). By the time this

layout diagram went into use, mobilization-type construction had been replaced by theater-of-operations type, introducing Spartan simplicity in an effort to effect all possible economies in buildings, roads, water distribution systems, sewage collection systems, and such. This "minimum-type construction" included reduction in the spacing between one-story structures from 40 to 30 ft, and in the width of firebreaks from 250 to 150 ft. In addition to the "space economies" resulting from these reductions, it was learned from the using service that divisional reviews were no longer a necessary part of training, and it was agreed that the width of the parade ground could be reduced from 1,500 ft between buildings to 900 ft without hampering its use for close-in drill for small complements of troops and for recreation.

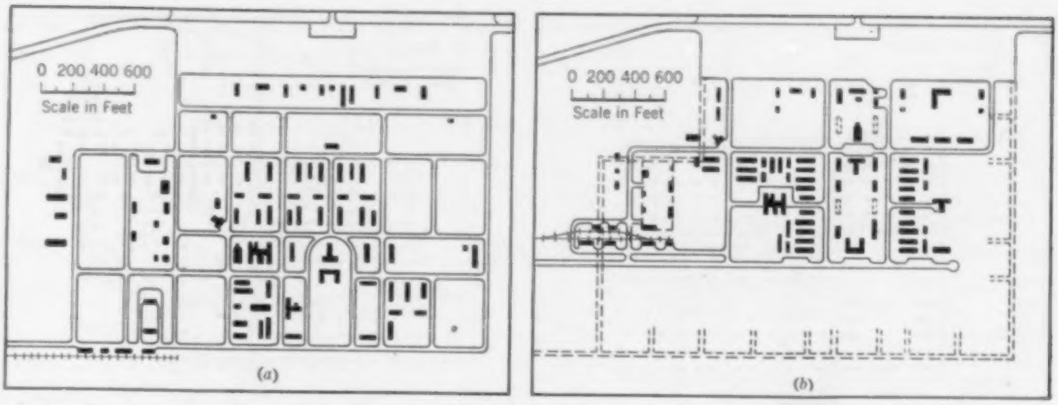


FIG. 2. AIRFIELD CANTONMENT LAYOUT: (a) OLD TYPE AND (b) NEW TYPE WITH SAME NUMBER OF STRUCTURES SERVED BY 51% LESS ROADS

It was also agreed that one formerly open end of the normal cantonment rectangle could be closed in with housing without interfering with troop traffic to training. It was found that, since the bulk of motorized traffic from motor storage areas to training areas could be in the direction of the arrows shown in Fig. 1 (*d*) rather than longitudinally along the division layout (as for example along Roads *D*, *D* in the other three schemes), these roads (*D*, *D*) could be deleted without bad effect. These savings resulted in a final layout embracing a network of roads totaling slightly more than 40,000 ft in length, or a 44% reduction over the original scheme.

ECONOMIES IN UTILITIES ALSO

Collateral economies in overall grading and in utilities also became possible. Scheme 1 covers, in housing, motor storage, and parade ground, approximately 564 acres, while Scheme 4 covers 425 acres, a 25% reduction in overall area to be graded. Since in normal practice a large proportion of the roads are paralleled by utilities, the economy resulting from the serving of approximately the same original number of structures with far fewer roads carried with it the potential proportionate economies in distribution of water, collection of sewage, and in supply of power. To these savings in construction cost may be added the great reduction in cost of maintaining the smaller total of roads and utilities.

It should be added that the division layouts that have been shown and compared are only a part of a total cantonment and that the whole cantonment houses normally more than twice the population accommodated within the skeleton layouts shown. The economical total to house and train at one camp was determined to be between 30,000 and 35,000 troops, of which the divisional layout shown in the four sketches accommodated only an infantry division of slightly less than 14,000 troops. The remainder of the 30,000 to 35,000 troops included either a second division or 15,000 to 17,000 non-divisional troops of various kinds.

Just as the advent of the automobile several decades ago resulted in the increased length and width of the city block, so the number of military structures to be served in a single block by a system of surrounding roads was increased. Obvious economies in road and utilities construction and maintenance resulted from breaking away from an earlier practice of housing such small units, as for example squadrons (six to nine buildings) in a single block, often surrounded by roads and

TABLE I. SAVINGS IN PIPING EFFECTED BY IMPROVED LAYOUT

Pipe Sizes	Old Scheme	New Scheme	% Saved
I. Water Distribution			
6 in.	6,290 ft	5,420 ft	13.9%
4 in.	11,850 ft	5,310 ft	55.2%
3 in.	710 ft	670 ft	5.7%
II. Sewage Collection			
10 in.	2,100 ft	1,880 ft	10.5%
8 in.	5,250 ft	3,670 ft	30.1%
6 in.	4,500 ft	3,080 ft	31.6%
4 in.	760 ft	1,060 ft	(39.0 increase)

utilities. Instead, the size of the block was increased to house several squadrons. The value of the application of this principle and of reducing the spacing between structures to the desirable minimums is shown in Fig. 2, in which an "old-style" design (*a*) is compared with a possible alternative "new-style" design (*b*). The second layout covers approximately 43% less area of overall grading and requires 51.6% less roads while still serving the same number of buildings and still allowing for adequate expansion. Possible reduction in cost of utilities by the "new-style" design is indicated in the Table I comparisons of the length of the larger sizes of pipe required.

COMMUNITY HOUSING

Construction of civilian war housing by the Corps of Engineers was confined to family and dormitory housing for personnel employed at projects which were on, or immediately adjacent to, military establishments. At sites other than those adjacent to military reservations, construction was accomplished by other agencies. As in the case of cantonment housing, it was necessary to set up criteria in Washington for use by field representatives as a guide in laying out the housing developments. The war emergency and statutory limits of $4,000 per unit demanded the strictest economy in funds used and the greatest possible conservation of critical materials; and these limitations necessitated careful planning to secure efficient results.

The housing was to be occupied by people whose health, comfort, and morale were an asset to the Government in its war effort. Efficient design was therefore of primary importance, and the field offices were advised to secure the best available professional assistance of architects and engineers. For the larger developments

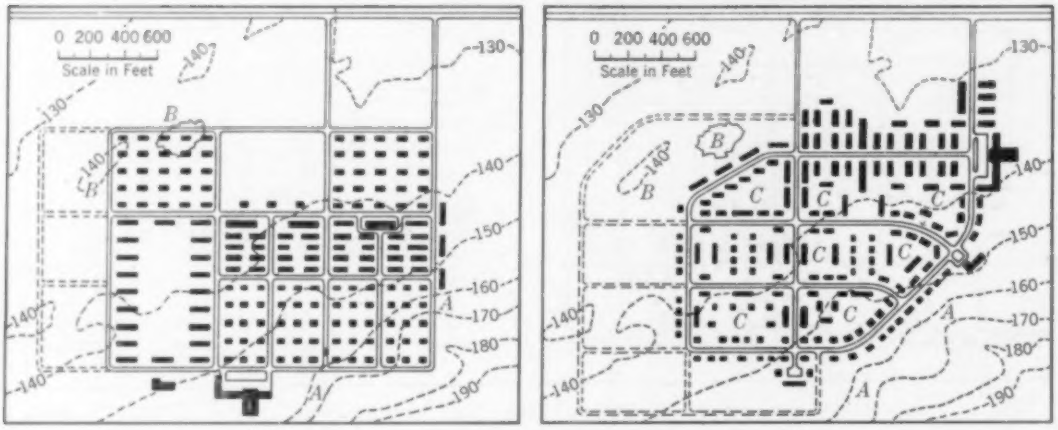


FIG. 3. LAYOUTS FOR CIVILIAN WAR HOUSING: (a) RECTANGULAR TYPE, AND (b) IRREGULAR TYPE, WHICH SERVES SAME POPULATION WITH 31.2% LESS ROAD LENGTH

(over 25 units), it was considered advisable to employ a well-qualified city planner on a consulting basis. Economy was the paramount issue—economy in money, in time, in labor, and in critical materials.

SITE PLANNING CONSIDERATIONS

The requirement that cantonments be located within 30 minutes' marching distance of small-arms ranges had its counterpart in civilian war community housing. It was considered desirable that this housing, if possible, be within 15 minutes' walking distance of the munitions plant or other place of work it served, provided that such a location did not interfere with special requirements of protective security of the plants, and provided that the distance from the plant was sufficient to ensure the safety of the housing occupants (in the case of plants manufacturing or storing explosives) as defined by ordnance and fire regulations.

As in cantonment housing, the spacing of houses for the sake of economy was kept as small as possible, but ample for protection against fire and for adequate light and air. Front to front or back to back, the long dimensions of buildings were kept to a minimum of 80 ft apart; end to end, a minimum of 30 ft for two-story buildings and 25 ft for one-story buildings; side to end, a minimum of 50 ft. No house could be built within 25 ft of a fire hydrant.

In order to avoid "regimentation" and the monotony of layout which might result from it, an effort was made to provide originality in each project by designing it to fit its particular location. Typical layout diagrams were generally avoided, and in their place the field offices were provided with samples of housing layouts annotated to describe good and bad features of planning. These samples showed the importance of the recognition of topography in the site plan, both in the layout of roads and in the grouping of buildings. To provide a degree of privacy, they suggested that family units be arranged in small groups in courts or cul-de-sacs. To avoid monotony it was recommended that different-sized units be mixed in a given group and that centers of interest could be obtained in such a group by using a two-story building as terminus to a cul-de-sac of one-story houses or by changing construction materials, using a brick house as accent in a group of asbestos-siding houses. Efforts were made to avoid "open-ended" compositions of buildings which looked out upon nothing or upon objectionable views, and to provide vistas to good views of water, hills, or other distant objects worthy of recognition (such as towers and church steeples).

The total costs construction s[…] lated in construc[…] directives had […] cover all overhe[…] salaries, and fees […] well as all utili[…] including gradin[…] roads, seeding, and reasonable amount […] planting of trees […] shrubs. It had a[…] to include the cost […] any land which m[…] be acquired and any equipment such space heaters, plum[…] ing fixtures, a[…] kitchen equipme[…] issued to the j[…]

From this it is clear that the cost of outside utilit[…] roads, and grading had to be kept to a minimum in ord[…] to avoid exceeding the statutory limit for this type […] construction, and that only the most economical type […] planning could be executed throughout the proje[…] That the advantages of well-considered planning, […] the comfort and morale of the occupants, did not nece[…] sarily increase the cost is illustrated by the comparis[…] of two theoretical schemes for the sizable project to […] described, shown in Fig. 3.

The site plans represent alternative studies for a pro[…] ect composed of men's and women's dormitories, fam[…] dwellings of two- and four-family units, eight-unit apar[…] ments for couples, a community center, and a school an[…] recreation area. The "regimented" rectangular schem[…] shown in Fig. 3(a) covers 68 acres as compared with […] acres covered by the irregular scheme shown in Fig. 3(b[…] thus requiring an increase of 19% of overall grading, an[…] some additional length of roads and utilities.

IRREGULAR LAYOUT HAS MANY ADVANTAGES

Approximately 50% of the street system of the fir[…] scheme accommodates houses on only one side of th[…] street, and the plan requires 16,046 lin ft of road to serv[…] ice the same number of structures as are serviced b[…] only 11,050 lin ft in the second scheme—an increase […] 31.2% over the latter. Failure to recognize the topogra[…] phy in the first scheme results in a monotonous layo[…] with heavy grading of a steep slope at A, A and rock ex[…] cavation at B, B; the scheme lacks distinction and do[…] not appear to be designed to fit the site. Avoidance […] the rock in the other scheme, and recognition of th[…] topography by permitting the rock outcrop and the stee[…] slope A, A to dictate portions of the layout, combi[…] to eliminate practically all heavy grading and provide […] degree of distinction and individual character of layou[…]

In the scheme shown in Fig. 3(b), the three types […] buildings that make up the family dwelling area are […] interspersed that there are no extensive repetitions of […] single type to give the monotonous result shown in th[…] other scheme. Courts and open areas, as at C, C, pro[…] vide recreation in better dispersed distribution than […] given by the two large open areas in (a). While […] was not possible, within the statutory limit of this type […] housing, to attain the degree of good architectural com[…] positions of groups of structures or of amenities normall[…] expected in housing of less limited cost, it is believe[…] that the application of the principles of planning de[…] scribed have contributed to a considerable degree to th[…] comfort and morale of the war workers thus housed.

Operation Pluto

Gasoline Pipe Lines Laid Under the English Channel

By A. C. Hartley

Technical Director, Britain's Petroleum Warfare Department

GASOLINE for Allied invasion forces in their eastward thrust across Europe was served up in enormous quantities through a pipe-line system laid under the English Channel. Over a million gallons a day were pumped through 21 lines from 31 to 70 miles long. This plan, developed by British engineers, guaranteed uninterrupted delivery of fuel without requiring extensive harbor and dock facilities and shipping capacity. As explained by Mr. Hartley in this article, two types of under-water line were laid—a woven cable and a continuously welded steel pipe.

OPERATION Pluto (pipe line under the ocean) received over one million imperial gal-s of gasoline daily from a 1,000-le oil pipe-line system in Great itain, and delivered it across the glish Channel to lines constructed ough France, Belgium, and Hol-d to Germany. Two types of e were used, the Hais (Hartley-glo-Iranian-Siemens), which was ilar to an electric cable with the e removed, and could be manu-tured, handled, and laid by ex-ing submarine-cable methods; and Hamel (Hammick-Ellis), a ndard steel pipe welded into a continuous length, und on to a floating drum, and unwound while being ed across the Channel. A trial length of 2-in. Hais le was manufactured in April 1942, then laid and ted in the Thames. This led to the manufacture of n. operational cable in a design allowing greater rking pressure. In late December 1942, a British ster, converted with special cable gear, successfully d a 30-mile length of the cable across the Bristol annel from Swansea to North Devon. In April 43, gasoline was delivered from shore to shore after siderable difficulties in laying connecting shore ds had been successfully overcome.

THREE-INCH CABLE

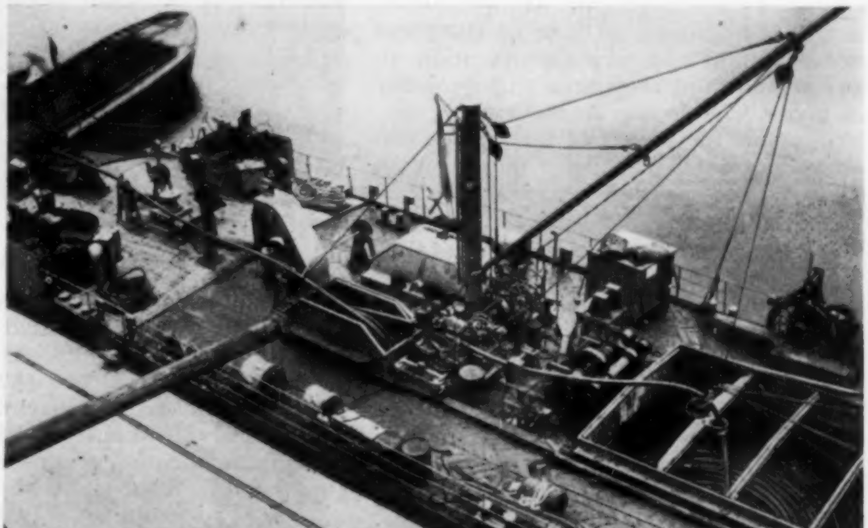
The Bristol Channel trials showed that a larger type cable could be handled, and it was therefore decided increase the bore to 3 in., with a corresponding in-ase of thickness in the steel tapes. A lead sheath of n. Hais cable has an internal bore 3.5 in., with a minimum lead thick-s of 0.175 in., and was manufactured drum lengths of 700 yd. The Hais ble is made up, from inside out, of a d sheath, a layer of tar, two layers paper tape, one layer of cotton tape, r layers of steel tape, tar, a single-ply e bedding, another layer of tar, oring wires, and two more alter-ting layers of tar and jute, the whole ng covered with whitewash.

The finished cable, full of water, ighs 63 tons per nautical mile, and s made in continuous lengths of 35 utical miles, coiled direct from the oring machine into special storage s to await loading.

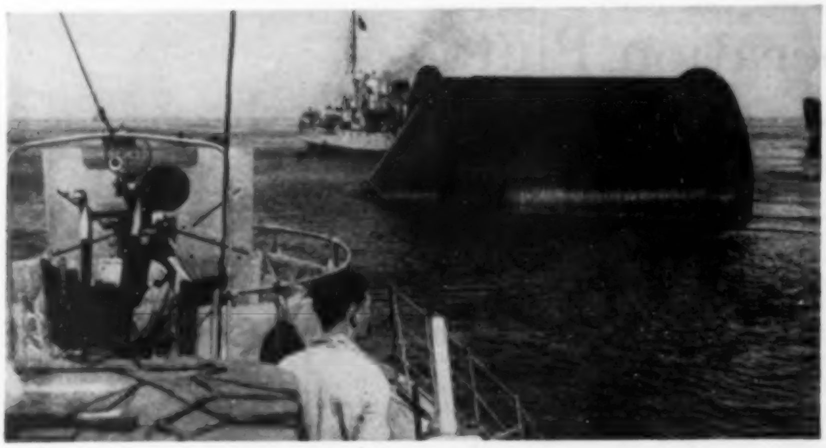
In addition to cable manufactured in gland, Phelps-Dodge erected a plant deep water at Yonkers, N.Y., in ich they installed two armoring chines, delivering cables to an espe-lly designed coiling site. This site d additional facilities for receiving ½-mile lengths of cable delivered down-coiled on four freight cars from the General Electric Company and Okonite Callenders, which were spliced into a continuous length at this site. General Cables Corporation also manufactured a length of cable at their Perth Amboy works, which is adjacent to deep water. The cable was delivered to the United Kingdom in ships fitted with especially constructed cable tanks. Of the total of 710 nautical miles of Hais cable used for Operation Pluto, 140 miles came from the United States.

Routine tests at cable manufacturers' works, in which a sample of cable was bent without pressure six times around a drum 6 ft in diameter, each time in reversed direction, gave an average bursting pressure of between 3,500 and 4,000 lb per sq in. It was decided therefore to operate the cables at a working pressure of 1,250 lb per sq in. Bursting disks were incorporated in couplings connecting the shore ends to the main cable so that individual lengths could be coupled without loss of pressure. The disks were burst by pumping pressure after the cable was laid.

The second type of pipe line was of continuous welded steel pipe. Tests were made at Britain's National Physical Laboratory on the behavior of a drum under tow, and full-scale trials of winding the pipe around a skeleton wheel were so successful that a factory was constructed for the welding of 20-ft lengths, and later of 40-ft lengths, of pipe $3^1/_2$ in. in outside diameter into 4,000-ft lengths, at the rate of 10 miles daily, with storage facilities for 350 miles. The thickness of the pipe was 0.212 in.



Cable Laying Gear Placed the Hais Type of Conduit

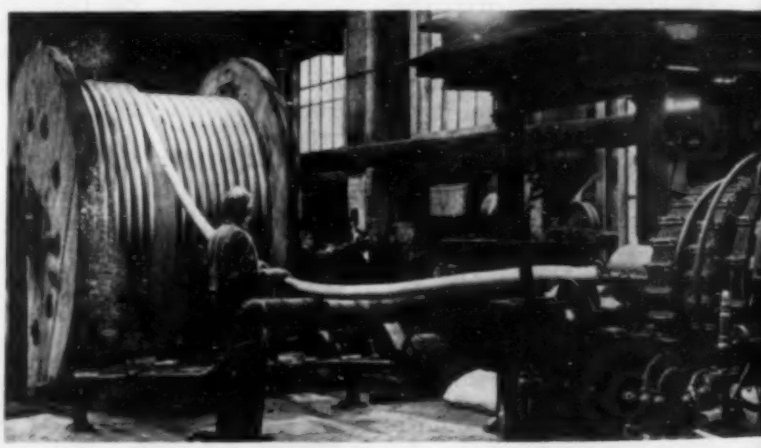


HAMEL CONDUIT WAS LAID FROM HUGE FLOATING DRUM

Each of the floating drums used to lay the pipe was 90 ft long, 40 ft in diameter, and had a length of 60 ft between flanges of 52-ft diameter. On the periphery of each flange there were teeth for rotating the drum in winding operations by a chain drive. The drum could carry up to 70 miles of 3-in. steel pipe at a time, weighing, with this length of pipe, 1,600 tons.

STEEL PIPE WAS STORED IN CONTINUOUS LENGTHS 3/4 MILE LONG

Two adjacent factories and storage sites were erected to weld the lengths of pipe. Standard lengths were welded singly, forming lengths of 4,000 ft. These lengths were then welded into a continuous line and wound on to the floating drums. In this operation, a floating drum was held in position by two arms at the end of a winding jetty. It was possible to ballast the drum so that at the commencement of the winding operation it was well down in the water, thus avoiding an undue wind load. As the winding proceeded and the weight of the pipe on the drum increased, the ballast of water was removed.



LEAD TUBING FOR HAIS CABLE COMING FROM CONTINUOUS EXTRUSION MACHINE

The laying force for the cable, called Force Pluto, was composed of ships of all sizes, from 10,000 tons to barges and motor launches. It numbered 100 officers and 1,000 men. Four cable-laying vessels were prepared for the operation. Two were designed to carry 100 nautical miles of 3-in. Hais cable, the third, 30 nautical miles, and the vessel used in first tests carried 15 miles of the cable. Thames barges carrying up to two nautical miles of 3-in. Hais cable were converted for handling the cable at the shore ends, where the drums of the laying ships could not operate.

Twenty-one pipe lines were laid in the English Channel, four being on the 70-nautical-mile route from the Isle of Wight to Cherbourg, and the remaining lines on the 31-nautical-mile route from Dungeness to Boulogne. On the long crossing, each line was laid in approximately ten hours, while the shorter crossing took just under five hours. On completion of the main lay, barges at each shore end picked up the cable end, connecting it to prepared lengths of Hais cable which they carried and ran in to shore, dropping the final end between high and low water, to be finally connected at low tide to steel pipes from the shore installation.

There are two terminals on the English coast, one on the Isle of Wight (the pumps being housed at Shanklin and Sandown) and the other at Dungeness. The Isle of Wight installation consisted at Sandown of 16 reciprocating and 2 centrifugal pumps and at Shanklin, of 8 reciprocating and 2 centrifugal pumps, the stations being connected by two steel pipe lines. Pipe lines feeding the pumps were carried from the mainland by both cables and steel pipe lines. Each line could deliver from 112,000 (pipe) to 120,000 (cable) imperial gallons at a pressure of 1,250 lb per sq in.

At Dungeness, 30 reciprocating and 4 centrifugal pumps designed for a pressure of 1,500 lb per sq in. were installed near the coast and were fed from the land-line system. Since the plant had to be installed in such a way that the enemy would not know the position or the purpose of the site, all erection and assembly were carried out at night. Bungalows and fishermen's huts scattered over a $3^1/_2$-mile shore road were not altered. Selected bungalows were used for housing the reciprocating pumps and their balance tanks (30 ft by 9 ft in diameter) without altering the outside appearance of the buildings. Inside, division walls were gutted and bullet-proof and blast-proof concrete walls were built for the pumps and tanks. Since the buildings were not large enough to accommodate the centrifugal pumps and the switchgear houses, these were built into a gravel pit, camouflaged with netting and shingle.

Federal Multiple-Purpose Projects

Part I. Planning Carried on by Three Agencies

By Alfred R. Golzé, Assoc. M. Am. Soc. C.E.
Assistant Director, Branch of Operation and Maintenance, Bureau of Reclamation, Washington, D.C.

CONSTRUCTION of giant multiple-purpose hydro projects in our Southern and Western states has proved itself the key to the development of vast regions of our country. As the scope of such projects is broadened, responsibility for planning and construction is often obscured. In an attempt to define the interrelation of several agencies, Mr. Golzé has prepared this article. A second part, discussing the financing of multiple-purpose projects, will appear in the following issue.

In Civil Engineering for November 1944, President Truman, then Senator Truman, directed attention to the task ahead in planning for a new period of productivity following the war. He emphasized that such planning should follow regional lines and that giant power-flood-reclamation projects are the key to the regional development of the economy of the United States. Funds are now available, and the federal appropriation bills for the fiscal year ending June 30, 1946, include large amounts for the investigation and planning of multiple-purpose projects. Of interest to engineers are the procedures being followed by the technical staffs of the Corps of Engineers of the War Department, the Bureau of Reclamation of the Department of the Interior, and the Tennessee Valley Authority in examining and evaluating the Nation's water resources for river basin development.

The federal government, although long the overseer of harbors and inland waterways and the constructor of irrigation projects, has been slow to approach the multiple-use development of river basins. The combined flood-control and navigation projects on the Mississippi and Sacramento rivers, and the irrigation systems with hydroelectric plants, which were authorized before World War I, are in a sense multiple-purpose projects. Actually only two specific multiple-purpose projects, defining such a project as a unit of a basin development, were authorized and put under construction before 1933. The first was the Muscle Shoals development on the Tennessee River, included in the National Defense Act of 1916 for improvements to navigation, development of water power, and production of nitrates and fertilizers, to be undertaken by the Corps of Engineers. The second was the Boulder Canyon Project Act, passed by Congress in December 1928, for the construction, by the Bureau of Reclamation, of Boulder Dam and power plant and for irrigation works to serve the Imperial and Coachella valleys in California.

The Tennessee Valley Authority Act, approved on May 18, 1933, began a new era in federal undertakings: "... in the interest of the national defense and for agricultural and industrial development ... to improve navigation ... and to control the destructive flood water in the Tennessee River and Mississippi River basins." Authority to take over the Muscle Shoals project and to undertake among other things the unified development of the Tennessee River system and the construction and unification of power systems is included in this act.

Extension of flood control programs—formerly limited to the Mississippi River and to California—to the entire nation was accomplished by the Flood Control Act of 1936, which included authorization for the installation in flood control dams of penstocks for the future development of electric power. The Bonneville Project Act in 1937, and the Fort Peck Project Act in 1938, authorized the War Department to generate power at these dams and the Secretary of the Interior to market that power. The Reclamation Act of 1902 was expanded in 1939 to establish rules for determining the feasibility of multiple purpose projects, with irrigation as the predominant feature. More recently, the Flood Control Act of 1944, and the Rivers and Harbors Act of 1945, have established procedures for the undertaking of multiple-purpose projects jointly by several federal agencies.

The divergent and painstaking paths traveled by the three largest federal agencies engaged in this class of activity from the initial investigation of a multiple-purpose project to its completion, operation, and maintenance, will now be traced.

CORPS OF ENGINEERS

Civil functions of the Corps of Engineers are accomplished through a system of 44 district offices scattered over the United States, Hawaii, and Puerto Rico, which report to 11 divisional offices. The division offices are under the direction of the Chief of Engineers at Washington, D.C. The Office of the Chief of Engineers is part of the Army Service Forces, but with respect to civil functions the Chief of Engineers reports directly to the Secretary of War. Each district office and each divisional office is directed by an engineer officer of the Army of the United States. Separate from the division and district offices, but attached to the Office of the Chief of Engineers, is the Board of Engineers for Rivers and Harbors, the Mississippi River Commission, the California

John Martin Reservoir, a Corps of Engineers Project in Colorado

ONE OF THE MOST RECENT PROJECTS OF THE BUREAU OF RECLAMATION IS SHASTA DAM

Reports involving multiple-purpose features, in which other federal agencies may be concerned, are made available to members of the Inter-Agency River Basin Committee, composed of representatives of the Corps of Engineers, Bureau of Reclamation, Department of Agriculture, and Federal Power Commission. A proposed report of the Chief of Engineers is also sent to the governors of affected states for their written views and recommendations, which are included in the report when it is sent to the Secretary of War and to Congress. As a last step, before submission to Congress, the relationship of the unfavorable preliminary examination and the survey and review reports to the program of the President is ascertained from the Bureau of the Budget, a procedure explained later.

Debris Commission, the Beach Erosion Board, the Shore Protection Board, and the Supervisor of New York Harbor.

The Corps of Engineers is prohibited from undertaking any project, study, or survey unless specifically designated or authorized to do so by Congressional action. Investigations are generally authorized in the rivers and harbors and flood control acts which are passed at intervals of several years. Between passage of such major acts, review of prior investigations may be authorized by resolutions of Congressional committees. In either case the authorized investigation results from a request of a member of the Congressional delegation representing the interested area.

On receipt of Congressional authority, the District Engineer makes a field reconnaissance of a proposed project and holds a public hearing to obtain the views and desires of local interests. He prepares a preliminary examination report, discussing the merits of the proposal, and this report, together with his recommendations for or against further study of the project, is sent to the Division Engineer. The Division Engineer examines the material submitted to him and directs it, with his findings, to the Board of Engineers for Rivers and Harbors in Washington. The Board comments on the field analyses and recommendations and may or may not concur in them. The District Engineer's report, with the subsequent review actions, then goes to the Chief of Engineers, who will order a comprehensive survey if he approves of the project. If he disapproves, after according sponsors of the project further opportunity to be heard, Congress is notified, through the Secretary of War, that the project is not advisable at this time. Favorable preliminary examination reports, approved by the Chief of Engineers, do not go to Congress.

The comprehensive survey report involves a complete study, with the estimates of cost and an economic analysis of the proposed undertaking. Prepared by the District Engineer and submitted through the same channels as the preliminary examination report, the survey report, after approval by the Chief of Engineers, is transmitted by the Secretary of War to Congress with a favorable or unfavorable recommendation. Favorable reports are complete with recommendations for the features to be included in the project, the participation of local interests, and the estimated cost of the works. The procedures that have been outlined are followed by the Corps of Engineers for multiple-purpose developments authorized for study under either the river and harbor or the flood control acts.

Reports for projected improvements to rivers and harbors, when received in Congress, are considered by the Committee on Rivers and Harbors of the House of Representatives, and by the Committee on Commerce of the Senate. Flood control proposals go before the House Committee on Flood Control and the Senate Committee on Commerce. The various reports, as received, are printed and numbered, as House or Senate Documents, if the recommendations are favorable. The authorization bills enacted every several years authorize the projects by reference to document number. The recommendations made by the Chief of Engineers, included in the reports, are adopted if the reports are accepted by Congress, and have the full effect of law in specifying the scope of the project development.

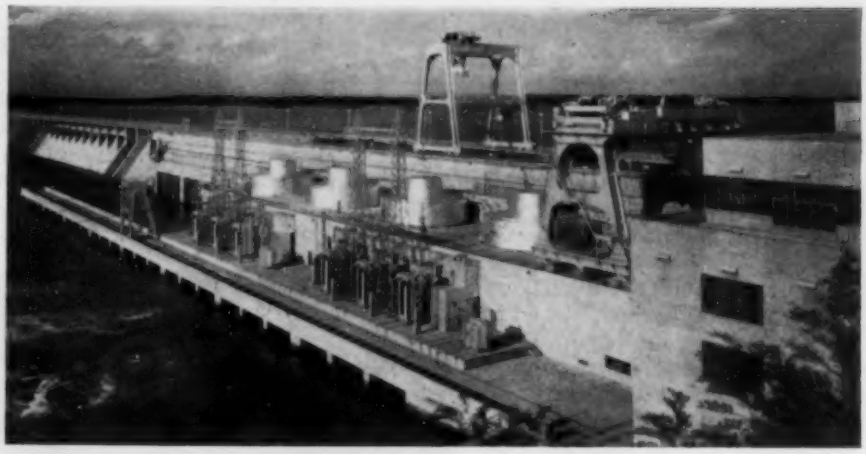
Thus, before a Corps of Engineers' multiple-purpose project is authorized, as many as ten separate review actions are involved—those by the District Engineer, Division Engineer, Board of Engineers on Rivers and Harbors, Chief of Engineers, governors of affected states, interested federal agencies, Secretary of War, Bureau of the Budget, House River and Harbor or Flood Control Committee, and Senate Commerce Committee. During the passage of legislation, further consideration is given on the floor of each chamber of Congress; and when the bill is ready for his approval or disapproval the President has before him a report from the Bureau of the Budget.

BUREAU OF RECLAMATION

Activities of the Bureau of Reclamation are at present limited by statute to the 17 western states. Its responsibilities are met through seven regional offices. Reporting to these offices are the projects under construction and those in operation. Field surveys of proposed projects are made by area engineers reporting to their regional offices. Projects under construction are in charge of construction engineers, and projects in operation are in charge of project superintendents. In charge of each region is a regional director, who reports directly to the Commissioner of the Bureau of Reclamation in Washington, D.C. The Commissioner is responsible to the Secretary of the Interior.

The Bureau of Reclamation initiates reconnaissance surveys of proposed projects, in accordance with a programmed schedule for investigation of river basins, and occasionally at the request of local interests or members of Congress. Under existing law the Secretary of the Interior has full authority to make such investigations

of possible projects as he deems advisable. Reconnaissance examinations are made by area engineers at the direction of the regional director. No formal reports are prepared or submitted to higher authority. If the regional director deems the proposed project worthy of further attention, a complete investigation is ordered. From this investigation arises a formal report prepared by the area engineer commenting on the engineering feasibility of the project, probability that its cost can be returned to the United States, and a recommendation for or against its construction. This project report is sent by the regional director to Washington for the approval of the Commissioner and the Secretary of the Interior. In some instances it may be held until other project reports on the same basin are available so that a consolidated report may be prepared.



FIRST MAIN-RIVER DAM CONSTRUCTED BY TVA WAS WHEELER, WITH A GENERATING CAPACITY OF 129,600 KW

Before submission to the Secretary of the Interior, drafts of reports are submitted to the Quadripartite Committee and to the governors of affected states in the same manner as are Corps of Engineers' reports. After approval by the Secretary of the Interior, reports are submitted to the Bureau of the Budget, where their relationship to the program of the President is determined, and thereafter they are transmitted by the Secretary to Congress. Accompanying favorable reports, and based on the information they contain, is a formal document known as a "finding of feasibility." In this document the

COMPLETED IN RECORD TIME AS A PART OF THE WAR EMERGENCY PROGRAM, FONTANA DAM OF THE TVA IS 480 FT HIGH

Secretary makes a determination, as required by the Reclamation Project Act of 1939, that the proposed construction has engineering feasibility and that the income from irrigation, power, and other sources will equal the total estimated cost of construction less non-reimbursable allocations to flood control and navigation.

On receipt of a finding of feasibility by the President and Congress, the project becomes authorized, and estimates of appropriations for its construction may be justified before the Bureau of the Budget and Congress. No positive action is required by either the President or Congress on the report or the finding of feasibility, although both have an opportunity to intercede with the Secretary of the Interior should they deem it advisable.

Should the finding of feasibility show that under existing law all costs cannot be returned to the United States, but that some alternative action must be taken to declare part of the costs non-reimbursable, then the report and appropriate recommendations must be approved by Act of Congress before the work can proceed.

Review actions on projects found feasible by the Secretary of the Interior are made by at least seven agencies: the Area Engineer, the regional director, the Office of the Commissioner, governors of affected states, interested federal agencies, the Office of the Secretary, and the Bureau of the Budget. Projects with non-reimbursable or unreturnable cost features not provided for by law are submitted to Congress. Before their authorization by Act of Congress they receive additional reviews—from the House Committee on Irrigation and Reclamation, from the Senate Committee on Irrigation and Reclamation, and on the floor of each chamber during their passage. There is also a final review by the President after the Act has been passed.

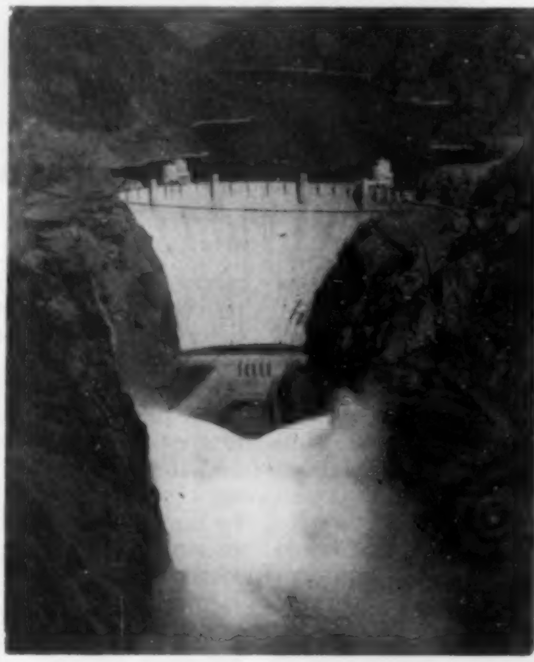
By statute the water control activities of the TVA are limited to the Tennessee River drainage basin, covering parts of seven southeastern states. Its responsibilities for the integrated development of all the resources of the Tennessee Valley region, including water resources, are met through one region-wide organization with major administrative offices at Knoxville and Chattanooga, Tenn., and Wilson Dam, Ala. The Board of Directors, General Manager, Chief Engineer, and other organization units have their offices at Knoxville. The Manager of Power and most of his staff have their offices at Chattanooga. Practically all physical research and manufacturing operations relating to fertilizer and munitions production are centered in Nitrate Plant No. 2 at Wilson Dam, Ala. A small Washington office provides a point of contact between the TVA regional organization and other federal administrative agencies.

The Tennessee Valley Authority Act contains statutory authorizations to enable the TVA to make and carry out a comprehensive program for the unified development of the Tennessee River system. Amendments made in 1935 provide for the construction and operation of such dams and reservoirs on the Tennessee River and its tributaries as will provide a 9-ft channel from Knoxville to the mouth of the river, control destructive flood waters in the Tennessee drainage basins, and alleviate floods in the Mississippi basin. The amendments further authorize the construction and operation of whatever power facilities are required to carry out its policies respecting the generation and the integrated utilization of the hydroelectric power resources of the region.

A comprehensive report prepared in 1930 by the Chief of Engineers and the various engineering organizations reporting to him, provided much of the best engineering

data on which the authorizations in the original TVA Act were based. The general plan of development authorized in 1935, and the specific objectives to be served by it, were embodied in the official TVA report on the *Unified Development of the Tennessee River System*, submitted to Congress in March 1936. This report confirmed the engineering feasibility of the plan of development previously authorized by Congress, and described by reference to specific projects how the plan could be accomplished. Within the TVA, the final responsibility for all engineering planning reports, and for the construction and operation of all major projects, is fixed by law in a board of three directors. In the discharge of its engineering, construction, and operating responsibilities, the TVA Board is assisted by various groups of TVA employees and consultants, whose work is directed by the General Manager of the TVA.

The Chief Engineer of the TVA, and the departments under his supervision, are primarily responsible for the continuing engineering studies needed by the TVA in planning its long-range water-control construction and operating program. His periodic reports to the General Manager, showing the relative merits of various combinations of potential future projects added to the system, provide the basis for Board-staff determinations as to which future projects deserve more intensive engineering investigation. The more intensive engineering investigation of each future project of high priority is authorized by the Board as a separate undertaking, and the use of funds for investigations of this type is controlled, project by project, under established TVA budget and authorization procedures.



BOULDER DAM, FIRST MULTIPLE-PURPOSE STRUCTURE ON THE COLORADO RIVER, COMBINES IRRIGATION, FLOOD CONTROL, AND POWER DEVELOPMENT

The engineering reports resulting from these intensive investigations are used as the basis for Board decisions and recommendations as to the construction of new multiple-purpose projects. Those projects authorized for construction, and for which funds are approved by the President and Congress, are built under the supervision of the Chief Engineer in accord with definitions of scope and schedules recommended by him and approved by the Board under established TVA budget and authorization procedures.

TVA DAMS AUTHORIZED BY ONE ACT OF CONGRESS

A total of 16 multiple-purpose water-control projects have been built by the TVA with its own forces in the last twelve years. It has taken over the operation of Wilson Dam and purchased five sizable dams from the Tennessee Electric Power Company. By agreement with the Aluminum Company of America, it has assumed operating control over five dams owned by that company on tributaries of the Tennessee River. In the case of the TVA, the entire system of dams was authorized by one act of Congress.

Individual new projects in the system receive at least six reviews before funds are made available—by the Chief Engineer, the General Manager, the TVA Board, the President with the aid of the Bureau of the Budget, the House Committee, and the Senate Committee acting as the appropriating body.

In processing reports prepared by the several agencies dealing with the feasibility of projects, the Bureau of the Budget since 1940 has been acting as the staff representative of the President in coordinating proposed undertakings. Executive Order 9384, issued in October 1943, continuing the 1940 procedure, requires that any reports concerned in any way with proposed planning or construction of public works by a federal agency must be submitted to the Director of the Bureau of the Budget for determination of the relationship of the report to the program of the President, before such report is submitted to Congress. The Director has established within the Estimates Division of the Bureau a Civil Works Section, the duties of which involve the consideration of these reports and the processing of estimates of appropriation for the investigation, construction, operation, and maintenance of such undertakings in the field of water resources. In reviewing the reports of the several agencies, particular attention is given by the Bureau of the Budget to conflicts or overlaps in investigations or proposals for construction in the same river basin, such as may occur where several federal agencies are operating in the same area.

Reports are further examined for their place in the President's program for the development of national resources. Those seriously in conflict with the responsibilities or proposals of other agencies, or lacking the justification of national interest, are returned to the originating agencies with suggestions for bringing them into accord with the federal program. The Bureau of the Budget does not attempt to exercise a technical review of the engineering features of any report.

In all the background work on these multiple-purpose federal projects, engineers play a prominent part. The field technical staffs of the agencies carry out the original investigations and surveys. These staffs are, for the most part, composed of graduate civil engineers. In the division offices of the Corps of Engineers, the regional offices of the Bureau of Reclamation, and the department offices of the TVA, engineers review the reports and proposals prepared in the field. In the Washington offices of the Corps of Engineers and the Bureau of Reclamation, engineers again are charged with the final review and preparation of the recommendations sent to the head of each agency.

The Commissioner of Reclamation and the Chief of the Corps of Engineers are both professional engineers. The responsible final review for the TVA is the duty of the Board of Directors. Such action is based on the recommendations of the General Manager, the Chief Engineer, and other responsible supervisors of the Authority. The Civil Works Section of the Bureau of the Budget, which considers the relationship of the reports to the program of the President, is staffed by engineers. The Director of the Bureau of the Budget, Harold D. Smith, is a graduate electrical engineer.

Soil Mechanics in the Design of Military Airfields

By G. E. Bertram

Major, C.E., Office of the Air Engineer, Headquarters, A.A.F., Washington, D.C.

"GET the rock on and the water off without delay." This order, often issued, states simply the attitude of military engineers charged with the construction of airfields. Time without number, runways in a theater of operations would have been churned into a sea of mud if subgrade had not been stabilized as the first construction operation. Concisely Major Bertram relates the principles of soils control which have made it possible for our air forces to assume and hold control of the air in battle areas.

AN increasing number of articles in popular, scientific, and news magazines to the ect that science has now elimited mud, indicates the extent to ich soil stabilization is achieving neral reader interest. This inrest has been heightened by the t that limited use is being made soil stabilization methods in the nstruction of military airfields d roads in the various theaters of eration. However, the popular scussions always stop far short of e complete story of the part that soil mechanics—of hich soil stabilization is only a part—is now playing in ilitary engineering, and manage to leave the impression at the entire subject can be summed up under the head soil compaction.

Development of Runway Design

The true picture of the accomplishments of soil meanics in military engineering can best be told by a ief discussion of the development of runway design and nstruction. To establish a background, it should be entioned that this branch of science was unknown in orld War I, when airplanes were first put to military e. The formulation of the theory of consolidation of il by Karl Terzaghi, M. Am. Soc. C.E., in 1919 may be nsidered as the basic framework upon which the new ience was hung. The first complete treatise on the subct was not published until 1925, and this was followed y instruction on the graduate level at a few universities. n International Conference at Harvard University in 936 accented the world-wide interest in soil mechanics, nd the *Proceedings* of the Conference furnished a wealth f quantitative data on soils and foundation problems hroughout the world.

Parallel with the development of theoretical soil mehanics, laboratories were established to determine the engineering properties of soils and, on the basis of these characteristics, to design the foundations of dams and buildings, flood control structures, highways, and various other earthworks. Pioneers in the application of soil mechanics to engineering problems in the United States were the Corps of Engineers in their nation-wide program of river and harbor and flood control projects. In Europe, the greatest progress in the application of soil mechanics was made in Germany, chiefly in the construction of the *Autobahnen*—the strategic network of military and commercial highways which was developed throughout the Reich.

When Time Permits, Steel Mats Are Rolled Back and a Gravel Subgrade Is Placed

When the United States undertook the national defense program, a major engineering problem was presented by the requirement for extensive runway construction at army airfields in every part of the country. The program was assigned to the Corps of Engineers, and the soil mechanics facilities of the Department were directed towards the solution of this new problem. Just as the basic requirement for an airfield is a runway, so the basic requirement for a runway is a good foundation. Unless proper subgrade conditions are found, improved by construction, and maintained by drainage, the best surface that can be provided by modern construction methods will fail.

Attention to Subgrade

Relatively speaking, a surface gives no more structural value to a runway than a coat of paint adds to the structural integrity of a building. This axiom is as old as the Roman roads, but the tendency has been to disregard the importance of an adequate foundation and to subordinate it to the quality and smoothness of the surface. For the relatively light loads imposed by auto traffic, the results of such practices were not of major consequence. This was due partly to the low concentration of stress, and partly to the fact that highways were a gradual development from country roads, and had had the compacting effect of countless traffic miles to stabilize their foundations.

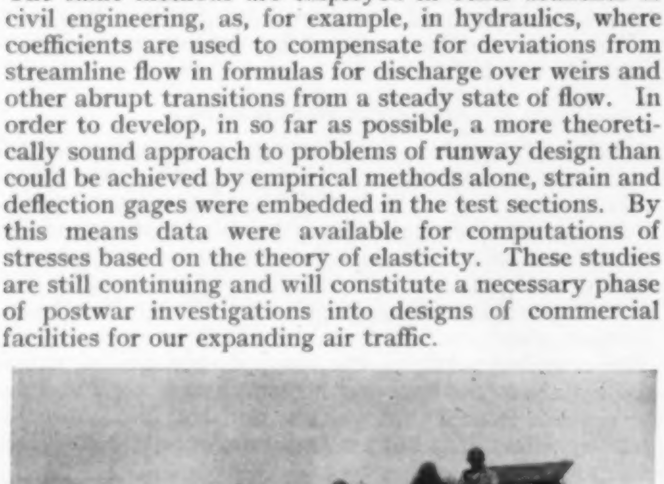
It was quite a different problem to start from scratch in a recently acquired cornfield, to provide an economical and sound engineering design for a runway to support wheel loads three to four times as great as highway loads. On the credit side of the ledger at the outset could be listed, first, the ability to recognize the engineering characteristics of a soil by simple identification tests and thereby predict its behavior within group limits; and second, the ability to determine by test the maximum density to which a given soil might be compacted and to reproduce these conditions in the field with construction equipment. On the debit side could be listed, first, the lack of a test method for determining the supporting capacity of a soil in place; second, the lack of a design procedure for determining the thickness of base required

between the subgrade and the actual wearing surface of the runway; and third, the reluctance of a large part of the engineering profession to recognize that loads imposed on a surface through pneumatic tires were of large magnitude, even though it was known that the weight of a plane might exceed that of a railway locomotive!

Research and construction necessarily proceeded together. A field bearing test based on the deflection of a plate loaded in increments was devised to measure the subgrade bearing value of soils for concrete pavements. The design of the concrete slabs themselves was based on a method of stress analysis which had been previously expanded to account for the larger contact area of airplane tires as compared with automobile tires. In the case of flexible pavements, an empirical method for the evaluation of subgrade support and the design of base-course thickness was adapted from the California Highway Department—called the California Bearing Ratio, or C.B.R. test. It was necessary to extrapolate the thickness design curves and to check the extrapolation by traffic tests with airplane wheel loads on test sections of pavement on various types of soil.

HEAVY RAINS AND TRAFFIC LEAVE A SEA OF MUD IN UNSTABILIZED AREAS

The empirical method of approach has been used on a number of problems in soil mechanics not only because of the requirements of expediency but also because theoretical soil mechanics deals with ideal materials, whereas natural soils generally vary from this theoretical concept. The same methods are employed in other branches of civil engineering, as, for example, in hydraulics, where coefficients are used to compensate for deviations from streamline flow in formulas for discharge over weirs and other abrupt transitions from a steady state of flow. In order to develop, in so far as possible, a more theoretically sound approach to problems of runway design than could be achieved by empirical methods alone, strain and deflection gages were embedded in the test sections. By this means data were available for computations of stresses based on the theory of elasticity. These studies are still continuing and will constitute a necessary phase of postwar investigations into designs of commercial facilities for our expanding air traffic.



LAYING PREFABRICATED BITUMINOUS SURFACING, WHICH REQUIRES AN EXCELLENT SUBGRADE

The early course of the war indicated that the Air Forces would be the first to be committed to action, and that airfields would have to be built rapidly for their use under a wide variety of construction conditions. Construction units, to be an integral part of the Air Forces, were considered essential to this task, and the Aviation Engineer battalions were formed. The organic equipment of these units was made up of the types of earth-moving and paving equipment used by the engineering contractor, revised to fit the particular needs of military construction. As a guide to these units in their work, a technical manual was prepared, TM 5-255, Aviation Engineers, the first manual in which soil mechanics data were published for military use.

PIERCED-PLANK MAT STANDARDIZED

Since speed of construction was of paramount importance to the Aviation Engineers, it was necessary to develop a surfacing material which could be laid faster than any of the standard types of concrete or asphalt paving. Steel landing mat was produced in various forms, and finally was standardized as pierced plank landing mat. In the early use of this mat, the problem of the relationship of the strength of the base to the efficiency of the surface wearing course was again evident. Manufacturers' advertisements in popular magazines claimed that the mats would transform a swamp into a landing field in a matter of hours. There was also a tendency on the part of engineers to smooth off a strip by grading, lay the mat, and assume that it would carry the loads imposed by aircraft.

It was noticeable, after the early operations in the Aleutians and North Africa, that the reports of battalion commanders and Engineer observers stressed the fact that a base course was required under the landing mat. Data were also furnished on the method whereby the steel pierced plank could be rolled up and crushed stone or gravel placed on the subgrade. This was then spread by bulldozers and compacted by rollers, and the mat was relaid.

Failures of mat were found to be due largely, not to failures in the design of the material, but rather to failures of the subgrade which permitted excessive deformations in the surface under load. Where an adequate base has been placed and drainage provided, airfields surfaced with landing mat have served for three years without

A Base Course of Crushed Stone Being Laid to Stabilize a Subgrade

signs of failure. Traffic of all types, from fighters and bombers to troop carriers and heavy transport planes, has been handled at peak concentrations as great as an operation every 2 minutes on the basis of a 24-hour day.

FIELD DRAINAGE AN ESSENTIAL

This discussion is not intended as an indictment in situations where urgency necessitated the laying of landing mat for emergency purposes. However, when circumstances permit, provisions for drainage and placement of a base on a subgrade before it has been remolded by traffic and churned into a sea of mud are most economical from the standpoint not only of operation but of equipment-hours and material. Two to three times as much rock may be required to convert mud into a runway as would be needed if the base had been prepared when the rock could be compacted against the stable soil. It is far easier to get water into soil than it is to get it out again. Put in its simplest terms, the motto of military engineers charged with the construction of runways should be, "Get the rock on and the water off without delay." This advice applies with equal force to military roads.

In addition to landing mats, admixtures used with soils to produce stabilized soil surfaces for runways, elicited much interest. The use of cement, chemicals, and bituminous products in small percentages was advocated as a rapid construction procedure. As in the case of landing mat, the formation of a stabilized surface layer did not eliminate the requirement for an adequate base. Most of these admixtures do not produce a layer of greater strength than the compacted soil itself, and regardless of the advisability of such treatment, the logistics of supply often operate against their employment.

Locations where such methods might be used to the best advantage are the very ones that are extremely remote from ready sources of the admixtures. For example, in North Africa, where there were French-owned cement mills, soil cement was not employed in the construction of runways because of the scarcity of coal. It would have been necessary to supply two tons of coal to produce one ton of cement, and the inadequate railways were already overburdened with more urgent military supplies. The development and use of local sources of base-course materials were dictated by the urgency of the situation, although the use of admixtures in construction might have provided facilities more rapidly could it have been employed.

To make possible a proper evaluation of the engineering properties of subgrades and local construction materials, regardless of their type, a field soil-testing set was assembled which provides means for making essential identification tests of soils, and also for determining their proper use in construction. A six weeks' course, "Control of Soils in Airfield Construction," was given at Harvard University to selected Aviation Engineer officers to familiarize them with test procedures. This not only made the design procedures and the experience of two years of construction in the United States immediately available for overseas use, but it meant that research conducted at home could be translated into designs in all parts of the world. For instance, the thickness of runway pavements for B-29 airplanes was determined from tests conducted with such planes as soon as they came from the factory, on sections of runway constructed in Georgia. The information so obtained was used to design the fields in China built by native coolie labor under the supervision of the Aviation Engineers. In the campaign through New Guinea and the Philippines, none of the fields failed through lack of adequate design, although the soils ranged from rock flour to coral, and the engineers were meeting them for the first time.

Coral Is Used Widely on Pacific Isles for Flight Strips

The development of soil mechanics in airfield construction during this war is indicative of the trend of future developments. Predictions of the wide use of admixtures to convert mud into solid ground should be looked upon with caution. More efficient equipment for construction and methods of utilizing a wider range of natural soils are a certainty. The exact methods and procedures employed by Germany for using soils in military construction are as yet unknown, but considering the basic principles involved, it cannot be seen how that knowledge can change the trends indicated by our own advances.

Education in soil mechanics has been gained by a large number of our officer personnel, and this will be reflected in our postwar construction activities. Soil mechanics will be a necessary course of study for military engineers, for, as General Godfrey states in his recent article in Civil Engineering on airfields in the Far East, "The successful airfield builder must have a good practical knowledge of soils."

Private Enterprise

An Unshackled Capitalistic System Urged in President's Annual Address

By JOHN CYPRIAN STEVENS, PRESIDENT, AM. SOC. C.E.

CONSULTING ENGINEER, PORTLAND, ORE.

SOME groups, both inside and outside of the government, seem to believe that the natural laws of economics can be repealed like man-made laws, and one would almost think that they are trying to repeal them. Acting under those natural laws this country has made the nearest approach to Utopia ever recorded in history. In the face of this historic fact it appears somewhat absurd and futile to attempt to substitute an artificial economy controlled by administrative edict and bureaucratic regulations.

THE CAPITALISTIC SYSTEM

This system, founded on the profit motive, has made the United States of America the outstanding nation of the world. We should not "pussy-foot" that statement but proclaim it boldly as a thing of which we have a right to be proud. That system produced the ships, the tanks, the planes, the munitions, the clothing, the foodstuffs that made it possible to outfit eleven million men and women and completely equip them for combat duty within a period of four years—an accomplishment unparalleled in the annals of the world.

Some may contend that the war capital was supplied by the government. Yes, but whence came the government funds? The answer is obvious. They came from my earnings and yours and from those of every other taxpayer.

Let us face the facts. Private enterprise and the capitalistic system have, during the past 150 yea s, built the railroads; cleared the forests; built irrigation systems; cropped the lands; mined the coal, iron and copper; launched ships; produced petroleum; erected the factories and power plants; designed and built automobiles, airplanes, "caterpillar" machinery; constructed highways; developed explosives, guns, electronics, communication systems; but above all they have produced officers of industry that, with the aid of free labor, knew how to turn their inventive and management genius to the business of winning a war. Patriotism supplanted profits and induced industry to carry on and produce in spite of many grueling regulations promulgated by well-intentioned but inexperienced and overlapping authoritative federal bureaus. Business has accepted this regimentation as a thing necessary to the war effort but will justly demand a respite when peace again appears on the horizon.

The capitalistic system and free competitive enterprise have made the winning of this war possible. That same capitalistic system, with the stimulus of free competition in cooperation with free labor operating under the natural economic laws of supply and demand, will make it possible to liquidate the unprecedented debt that now hangs, like the sword of Damocles, over this nation.

Any attempt to continue the artificial manipulation of prices and the harrowing control of management after the war necessity therefor has passed, can only result in inflation with its consequent repudiation of values and its unthinkable social effects. Taxes must be reduced. The present hazards of conducting business efficiently must be eliminated. Surplus earnings must be allowed in some reasonable degree to provide for expansion of industry. Risk capital must foresee reasonable profit or it will not be forthcoming but remain nestled among government securities. If private enterprise cannot take the helm, the national income will sink to sickening levels and we will again find ourselves in a Slough of Despond.

REGULATION

Wholesome and intelligent regulation, by law, of business activities to insure that they are carried on in a truly competitive field, will have the continued support of the Nation. Such affairs as the Insul and Foshay debacles must not again be allowed to besmirch the good name of well-conducted enterprise and give ambitious politicians the ammunition for broadsides against corporations in general, and honestly acquired wealth and competence in particular.

Private enterprise is the only system that can solve unemployment. But to do so it must be permitted a fair field, unshackled by excessive taxes and meddlesome regulations, and stimulated by a stable policy of fair dealing, with only sufficient intelligent control to insure that its operations are truly competitive. Under such conditions small businesses will spring up all over the country; a portion of profits will go back into the businesses; financing by private sources will be the order of the day; expansions will follow; new plants will be built; and unemployment will be reduced to a minimum.

In brief, unhampered private enterprise operating under a constructive labor policy, encouraged by a reasonable scale of rewards to both labor and management, will keep this nation operating with a high degree of business stability, balance the national budget, and pay off an unprecedented national debt.

THE ENGINEER HOLDS THE STAGE

The engineer will play a most important role in the revitalization of the world for peacetime pursuits. His is the task of converting industry to produce consumer goods in lieu of war materiel and munitions. He must design the highways and airways, the modern streamliners of rail and stratosphere, improved radio, television, automobiles and trucks, household appliances, office equipment, air-conditioned housing, modern buildings, industrial instruments, communication systems, bridges, tunnels, and subways. He must not only design, but he must prepare specifications, execute contracts, and supervise construction. He just about occupies the center of the stage all the time.

All these—and yet he is virtually without honor save among his own colleagues; as witness the recent National Council for International Organization at San Francisco. The list of organizations asked to send representatives as consultants occupied several typewritten pages and included labor unions, service clubs, Jewish, Catholic and Protestant groups, lawyers, guilds, many social and professional organizations, but not one representative of either a national or local engineering society. And why? Because the engineer is not organized into pressure

[g]roups. He devotes time to civic service only on special [r]equest. He can solve technical problems but is rarely [co]nsulted on human problems. Public relations for him [a]re merely word sounds without an urge to action. Poli[ti]cs is almost anathema in his thinking. He appears to [p]refer being left alone in his own technologic world with[o]ut fanfare or encomiums.

The engineer does not yet fully realize that his useful[n]ess to humanity would be enormously increased if he [w]ould take public relations to himself as a problem to be [so]lved in the same earnestness with which he approaches [t]he solution of a technical problem.

The engineer is no dullard. In cultural matters and [a]ccomplishments, he will easily march abreast of those [i]n other vocations. He can and must broaden his social [h]orizon if he hopes to play effectively his part in getting [t]his turbulent world back on an even keel.

He should take an interested part in civic affairs; [j]oin service and social clubs, chambers of commerce; serve on committees; learn to speak effectively in public; become interested in people and tolerant of their opinions. He'll soon find himself on important committees, on boards of direction in industry and finance; and his advice and counsel will be solicited on all important matters.

Private enterprise must be manned and managed by men of integrity, of analytical mind, of technical ability, of sound judgment; men who are cooperative with labor and who so conduct their businesses as to hold the support and confidence of the public. To such positions the engineer should aspire.

Such enterprises, so managed, can accomplish the objectives herein set forth of balancing the budget, of maintaining the national income at a high level, and of paying off the most staggering debt that has ever been faced by any country in the world. It is vital that the public and Congress recognize the full import of that potentiality and give private enterprise the opportunity to justify our faith in it.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

A New Structural Steel Angle Tested

By Jonathan Jones, M. Am. Soc. C.E.

Chief Engineer, Fabricated Steel Construction, Bethlehem Steel Company, Bethlehem, Pa.

In connection with a Marine application, certain mills have prepared rolls for, and have furnished, a new [a]ngle, of nominal size 9 by 4 in. It has been rolled [l]argely in the $^{9}/_{16}$-in. thickness and to a much less degree [i]n $^{1}/_{2}$-in., and is being catalogued only in those two [t]hicknesses and $^{5}/_{8}$-in. These angles should logically [b]ecome popular for truss, girder, and column design, and [i]nasmuch as the 9-in. leg would seem to border on the [l]imits of stability under compression, they afford a con[v]enient opportunity to test existing specifications and the [u]nderlying theory.

In the A.I.S.C. Specifications for Structural Steel in [B]uildings, it is specified (Sect. 14c) that the ratio of leg [w]idth to leg thickness shall not exceed 12 for girders, [c]ompression columns, and main compression chords of [t]russes; or 16 for other compression members. In the A.R.E.A. Specifications for Steel Railway Bridges these [l]imits (Art. 406) are 12 and 14, respectively. For the 9-in. leg of the new angles that ratio is, if $^{5}/_{8}$ in. thick, 14.2; if $^{9}/_{16}$ in. thick, 16.0; if $^{1}/_{2}$ in. thick, 18.0.

Three pairs of test columns were accordingly designed [a]nd fabricated, as shown in Fig. 1. The following [p]oints will be noted:

1. The columns are rectangular, and symmetrical [a]bout both axes, and the center of the enlosed area is the [g]ravity axis of the column. This simplified the securing [o]f central loading.
2. The radius of gyration on one axis is so much [g]reater than that on the other (3.25 in.: 1.78 in.) that [t]here could be no confusion as to the critical axis for [c]olumn failure.
3. The two angles are welded together for 12 in. of [l]ength at each end only. This should in principle render [e]ach angle an independent, uniformly loaded column. Each such angle should fail independently of the other, by buckling on its *Z-Z* axis, viz., that of minimum radius of gyration, unless twisting of the 9-in. leg should precede.
4. There are three different unwelded lengths of angle; 17 in., 68 in., and 119 in. Since the radius about the *Z-Z* axis is 0.85 in., the three length-ratios are 20, 80, and 140, so that the range of permissible lengths for "main" compression members is more than covered. (If the columns had been sufficiently welded for integral action, the corresponding length ratios would have been 23.0, 52, and 80.)
5. The individual angles are able to rotate about some vertical axis, between the end welds. The support given by the angle to its weak edge is therefore less than it would be in a truss, girder or column, where ordinarily pairs of angles would be riveted to a stem-plate or web-plate, and rotation of the angle as a whole would be prevented. This test is therefore the most severe practicable, for the crippling of the 9-in. legs.

Tests Run at Lehigh

The six columns were fabricated by Bethlehem Steel Company and tested at Lehigh University by M. O. Fuller, M. Am. Soc. Soc. C.E., Assistant Director of the Fritz Laboratory. In this memorandum only a brief statement of the test results is given, but complete laboratory data will be made available to specification writers who are interested. All columns were tested in an upright position, between a spherical bearing block at their upper, and a square block at their lower, ends.

Referring to the work of Messrs. Moisseiff and Lienhard, Members, Am. Soc. C.E. (Transactions, Am. Soc. C.E., 1941, pp. 1052 ff.) and accepting the authors'

physical constants and nomenclature, Eq. 1 may be restated:

$$\sigma_{cr} = 26{,}200{,}000\, k\, \zeta \left(\frac{t}{d}\right)^2$$

in which σ_{cr} = critical compressive stress; k = stability coefficient; ζ = modulus factor; t = thickness of plate; and d = width of plate.

For a 9 by 4 by $^1/_2$ angle, accepting the statement made in the first paragraph on page 1060,

$$\frac{t}{d} = \frac{^1/_2}{9 - 2 \times {^1/_2}} = \frac{1}{16}$$

Accepting k = 0.43 (page 1059) and the relationship between ζ and σ given in Table III (page 1057),

$$\sigma_{cr} = \frac{26{,}200{,}000 \times 0.43 \times 0.71}{16 \times 16} =$$

31,000 lb per sq. in. (about)

According to the authors, the value of 0.43 for k accords with complete freedom of the angles to rotate, which was present in these tests. Accordingly at an average unit stress of 31,000 lb per sq in., these angles would be expected to fail by rotational crippling of the 9-in. legs. This is on the assumption, of course, that the angles would not fail at a lower load from general column action.

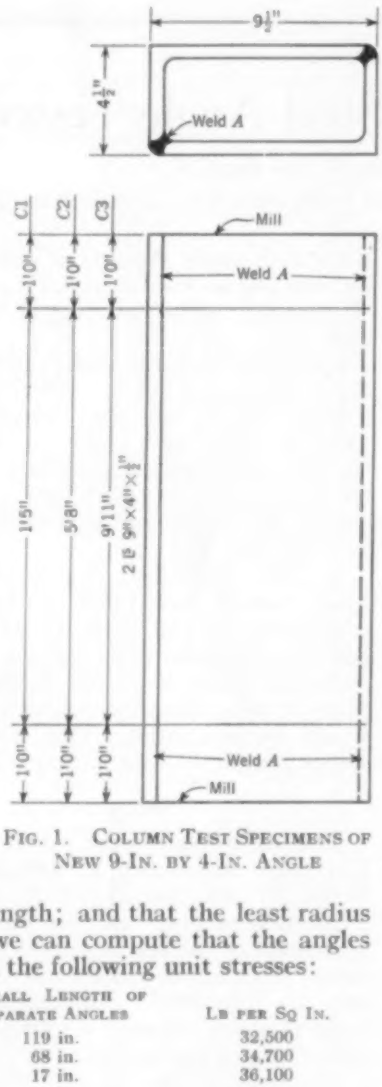


FIG. 1. COLUMN TEST SPECIMENS OF NEW 9-IN. BY 4-IN. ANGLE

Entering the general secant formula for column failure with the assumptions that E = 29,400,000; that the yield point of the material is 38,000 lb per sq in. (coupon tests showed 38,200 to 41,300 drop of beam in tensile test; on the other hand short compression specimens, for which stress-strain diagrams were plotted, showed definite yield points—slope = $1^1/_2$ times original—at 29,000 to 36,500); that eccentricity of loading is such that ec/r^2 = 0.05; that for one fixed end and one pinned end the length for flexure is 0.8 times the overall length; and that the least radius of gyration is 0.85 in.; we can compute that the angles should fail as columns at the following unit stresses:

COLUMNS	OVERALL LENGTH OF SEPARATE ANGLES	LB PER SQ IN.
3 A-D and 3 B-C	119 in.	32,500
2 A-D and 2 B-C	68 in.	34,700
1 A-D and 1 B-C	17 in.	36,100

The failure loads predicted by averaging the A.R.E.A. formulas for riveted and pin ends and multiplying by the intended factor of safety therein, 1.76, would be:

COLUMNS	LENGTH-RATIO	LB PER SQ IN.
3 A-D and 3 B-C	l/r = 119/0.85 = 140	16,250
2 A-D and 2 B-C	l/r = 68/0.85 = 80	23,150
1 A-D and 1 B-C	l/r = 17/0.85 = 20	26,150

The discrepancy between these two tabulations shows the effect of assuming ec/r^2 = 0.05, as is not unreasonable in this case, as against the assumption of 0.25 which underlies the A.R.E.A. formulas, in 'contemplation of frame action; and of assuming 38,000 lb per sq in. as the yield point, as against 33,000 permitted by the material specifications.

TEST RESULTS COMPARED WITH PREDICTIONS

The actual unit stresses at failure appear in Table I.

TABLE I. ACTUAL UNIT STRESSES AT FAILURE

COLUMNS	LENGTH FT-IN.	FREE LENGTH OF ANGLES FT-IN.	TOTAL LOAD AT FAILURE LB	NOMINAL AREA SQ IN.	UNIT STRESS AT FAILURE LB PER SQ IN.
3 A-D	11-11	9-11	373,000	12.5	29,840
3 B-C	11-11	9-11	421,500	12.5	33,720
2 A-D	7-8	5-8	453,000	12.5	36,240
2 B-C	7-8	5-8	486,000	12.5	38,880
1 A-D	3-5	1-5	463,000	12.5	37,040
1 B-C	3-5	1-5	484,000	12.5	38,720

Of the two long columns, one failed below and one above the 31,000 lb per sq in. predicted for local failure. One carried less, and one carried more, than the 32,500 predicted (rather rashly predicted, considering the lack of any real knowledge of the initial eccentricity) for general column failure. But both long columns failed by long column bending and twist, with no visible indication that failure by a local yield was imminent.

The medium-length columns both failured by sudden deflection as a whole, combined with, and most probably caused by, a simultaneous local crippling of one 9-in. leg (36 in. from the top of column 2 A-D, and 34 in. from the bottom of column 2 B-C). Unlike the two long columns, both of these showed a permanent distortion (closing) of the angles, from the original 90° opening in the region mentioned. These columns therefore failed by reason of b/t crippling, but at total loads above those predicted either for such crippling or for column action. At the instant of failure, both the long and the medium-length columns rotated at the upper, spherical bearing, while remaining normal to the lower, square bearing.

The short columns both failed without general column failure, by crippling of both 9-in. legs (one more pronouncedly than the other), but at total loads far above that predicted for such crippling and well above that predicted for general column action.

The instrument readings taken during the test comprised (1) overall shortening, (2) compressive unit stress at tip of 9-in. legs at mid-height, and (3) distortion in a horizontal plane at tip of 9-in. legs, at mid-height and quarter points. (These measurements (3) are somewhat inconclusive, because the greatest distortions did not necessarily come at the levels where the instruments were set.) When the curves of all these deformations had been plotted against load, there did not seem to be any reason to alter, with respect to yield, the conclusions reached from the ultimate loads.

The following conclusions are offered: (1) For use as single-angle, centrally loaded struts, the capacity of the new 9-by-4 angles computed by column formulas in standard specifications need not be in the least reduced by fear of local instability. (2) The same is obviously still more true when the angles are used as component parts

of columns or girders, in which they are not free to rotate independently. (3) The specification limits on the width-thickness ratio of the outstanding parts of columns and girders are probably too severe and would bear reexamination.

It has already been pointed out (by H. D. Hussey, M. Am. Soc. C.E., Transactions, Am. Soc. C.E., 1941, p. 1102) that the recommendations in Table 4b (*ibid.*, p. 1059) of the Moisseiff-Lienhard paper, previously referred to, are more severe on the outstanding parts of columns than a strict analysis would require. Since they are in turn in close agreement with specifications, Mr. Hussey's comment lends force to the third conclusion drawn from the tests reported here.

Span Launcher Improvised by Army Engineers

By Harry Hulen

Colonel, Corps of Engineers, U.S. Army

Since they hit the Normandy beaches, the Engineers have indulged in some plain and fancy improvising to keep our Armies moving irresistibly into Germany. The typical Yankee urge to tinker, combined with sound engineering principles, produced some interesting and beneficial results. For sheer size, probably none of the Engineers' brain children surpasses the 347th Engineer Regiment's improvised bridge-span launcher.

A Bridge Launcher, Similar in Function to That Devised by the 347th Regiment, Erecting a Bridge Across the Moselle River in France

This launcher is a 27-ton monster steel truss mounted on a flat car. An Engineer officer or soldier might give a more technical description, but the improvised bridge-span launcher is actually what its title implies. Its function is to pick up a prefabricated railroad span of up to 75 ft., complete with beams, rails and ties, with heavy-duty blocks and drop it into place on previously installed piers. Then the apparatus can walk over the completed bridge and look for another suitable task for a heavyweight.

It sounds like an easy way to an "assembly-line" method of bridge building. Actually, it isn't that simple. There were no formally designed plans for the launcher. The idea for it came to the writer during the planning stages of the trans-Rhine railroad bridge at Mainz. The details were carried out with a crew of 12 welders and four rigs at the group's supply depot some distance from the site of the bridge. Selecting steel that would be unsuitable for bridge construction for various reasons, the Engineers worked steadily on the improvised steel gargantua. The work went smoothly. When they joined the top-cord members for the apex of the truss they had to cut to within one-sixteenth of an inch from the angle computed by Capt. William Ott, its designer.

The equipment was completed in 19 days and mounted on two flat-cars. Meanwhile, construction on the bridge at Mainz had progressed at a pace that amazed even the Engineers working on it. The Mainz bridge was completed in $9^1/_2$ days, and is regarded as one of the outstanding engineering feats of the war.

The launcher cuts launching time down more than 25%. It will increase efficiency throughout a bridge operation, with men working on the assembly of the span while others set the piers. With a store of spans all made up, the launcher can walk out, drop a span, and go on walking to another job.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Caesar Did It, Too, But Differently!

To the Editor: Exactly 2,000 years ago—in 55 B.C.—Julius Caesar had the same objective at the same place and against the same enemy that General Eisenhower recently had. Both must cross the Mississippi-like Rhine to conquer the barbarous and war-like Germans.

Caesar's solution of his problem is set forth in his *Gallic Wars' Commentaries.* The intricacies of his bridge at Koblenz (Book 4, Chapter 17) has caused generations of secondary school students to sweat and groan; perhaps thousands of these sufferers were in the forces that made the crossings last March to May. Certainly the novel methods used by General Eisenhower will also be recorded in history for generations to come. Incidentally, Koblenz was

headquarters for the American Army of Occupation after World War I; the 6th Engineers, U.S. Army, built a strong pontoon bridge there that was used during the occupation by General Allen's forces.

The Roman found no ready-made Ludendorff Bridge for quick establishment of an east-bank bridgehead. Nor had he our Army's assault boats and Bailey bridges nor the Navy's LCM, and LCVP nor an airborne force with low-flying transport planes. Nevertheless, the wooden trestle bridge his engineers threw across the Rhine at Koblenz (only 25 miles upstream from the recent Ludendorff Bridge at Remagen) served him well. It took 10 days to build it; the American engineers put one of their bridges across in 9 hours.

Caesar expected that the Germans would try to wreck his structure by floating great trees downstream against it. So he drove heavy clusters of diverter piling upstream, and these saved his bridge several times.

Rochester, N.Y. RALPH Z. KIRKPATRICK

Multiple-Purpose Reservoir Operation

TO THE EDITOR: Mr. Blee's paper on multiple-purpose reservoir operation of the Tennessee River system, which appeared in two parts in the May and June issues, is a valuable contribution to the study of reservoir and watershed planning. It is of particular interest to the writer because it was almost exactly ten years ago that he was asked by the Tennessee Valley Authority to testify (Ashwander, *et al.* vs. TVA, *et al.*) that the proposed Norris Reservoir multiple-purpose operation was feasible inasmuch as it would be similar (although on a greater scale) to the operation of the Sacandaga Reservoir, which was designed and constructed by the writer and which had then been in multiple-purpose operation for flood control, navigation, and power for five years.

The multiple-purpose operation of the Sacandaga Reservoir, which is on the Hudson River watershed, was described by the writer in the November 1938 issue of CIVIL ENGINEERING. The article was illustrated with hydrographs and duration curves, showing the efficacy of the reservoir in the reduction of floods on the Hudson River and also in regulating the low-water flow of the river for power and navigation. At that time much had been written on the impracticability of the multiple-purpose operation of storage reservoirs, but it is obvious from Mr. Blee's paper that all these purposes have been successfully accomplished in the operation of the TVA reservoir system.

The parallelism of many of the characteristics of the Tennessee River watershed to those of the Hudson River watershed is interesting. The drainage area at Norris Reservoir is 2,912 sq miles and of the Tennessee River at Chattanooga 20,790 sq miles, a ratio of 1 to 7.1; whereas the drainage area of the Sacandaga Reservoir is 1,044 sq miles and of the Hudson at Albany 8,100 sq miles, a ratio of 1 to 7.8. Moreover, the total storage at Norris Reservoir is 12.5 in. on its watershed, whereas at Sacandaga it is 13.7 in. with approximately the same mean annual rainfall.

Of particular interest is Mr. Blee's Fig. 3 (Part I) showing the distribution of floods on the Tennessee River. One considerable difference in the occurrence of floods on the Tennessee and Hudson watersheds is due to the fact that there is no serious snow problem on the former, whereas on the Sacandaga and Hudson watersheds elaborate snow surveys must be made to assist in forecasting the spring runoff. It is fortunate for the TVA engineers that the serious floods in that area are limited to the months of January, February, March, and early April. While the frequency and volume of floods in the North Atlantic States are greater in the spring than in any other season, the September 1938 hurricane produced record-breaking flood peaks on many of our streams, although in northern New York little damage occurred. At that time the Sacandaga Reservoir was well depleted, and the rise of 3.3 ft in 48 hours was of no concern. Generally the summer and fall floods are flashy and have not as great volume as the spring floods so that they are easily controlled in a storage reservoir where proper allocation has been made for flood control. In northern New York, with rare exception, the great floods result from a deep snow blanket and a warm melting rain, and it is imperative that at that time of the year substantial flood storage be available.

It must be admitted, of course, that until accurate long-range weather forecasts can be made, no guarantee can be given that multiple-purpose reservoir operation will completely serve all the various purposes. However, there are probably available many storage reservoir sites which are not economically sound for those combined purposes. It must be kept in mind, though, that the operation of any multiple-purpose reservoir requires absolute integrity on the part of the operation agency to withstand any temptation to sacrifice flood storage for power purposes.

EDWARD H. SARGENT, M. Am. Soc. C.E.
Chief Engineer, Hudson River Regulating District

Albany, N.Y.

Design of First Floating Drydock

TO THE EDITOR: A statement, in the June issue, to the effect that Rear-Admiral William H. Smith was in charge of the "design of the Navy's first floating drydock" came as a surprise. It is recollected that two large floating drydocks were constructed for the Navy by the Maryland Steel Company at Sparrows Point (in Baltimore Harbor), Md.—the one about 1901 and the other around 1905.

It is said that the first of these two drydocks, which was about 500 ft in length, was towed from Baltimore to the Naval Station at Algiers (on the Mississippi River), La. The other dock, of similar length, was named the Dewey Dock and towed, via the Suez Canal, from Baltimore to the Philippines. It has been reported that the Dewey Dock was wrecked just before the fall of Bataan in 1942, to prevent its use by the Japanese.

Baltimore, Md. JOHN S. DOYLE, M. Am. Soc. C.E.

Adoption of Metric System Deemed Unwise

TO THE EDITOR: A demand that the United States adopt the metric system is again raising its head. Arguments for its adoption ignore absolutely the inconveniences and confusion it would mean to every man, woman, and child who can read or talk.

Arguments for the metric system are puerile. Decimals for computing areas and volumes are more convenient. What is to hinder one who wishes to make such computation from using tenths of a foot? And how often does the average man want to compute areas or volumes? Another argument is the large area in the earth where the metric system is a standard. China is cited. It is doubtful if in all of China there is as much reference to any system of measuring anything as in one ordinary town in the United States.

Decimal division in our money is good and convenient. It simplifies adding columns of money values. The dime and the penny are the only decimal divisions of the dollar. The half, the quarter, the nickel, follow the "human" tendency to divide by two.

Some laboratory and scientific workers would have their work simplified by decimal division; others would be greatly hampered. The thousandth of an inch is used every day by thousands of workers making tests and machinery. What substitute would we have in the metric system?

Imagine requiring steel to show such values in tensile strength as 38.7 kilograms per square milimeter, the strength of a little wire! And think of the work entailed in converting all specifications for steel into foolish requirements such as these, to say nothing of complete revision in the books and the thinking of structural engineers. The vast expense of converting all measuring, weighing, and testing devices, and all tool machinery, to a new system would benefit no one.

The supposed saving in the schools by the adoption of decimal measurements would turn out to be a perpetual source of headaches for generations to come in conversions between the system now in use and the metric system, if we should be so unfortunate as to have it forced upon us.

In the metric system there are the millimeter, the centimeter, the meter, and the kilometer—jumps of 10, 100, and 1,000. (The decimeter is not used.) In our system we have as definite and familiar units $^{1}/_{16}$ in., $^{1}/_{8}$ in., $^{1}/_{4}$ in., $^{1}/_{2}$ in., 1 in., 1 ft and, if needed, the rod, furlong, and mile. All these units are needed, when one judges or talks about the size of things. It is impossible for the human mind to think of 75, 100, 300 things in a row and judge their length on that basis. A 75-millimeter shell will be thought of by one familiar with this size, as 3 in. Such dimensions as $^{3}/_{8}$ in.

in., can be judged because of their relationship to an inch or a foot.

In weights, the gram is almost microscopic—one could scarcely see it in a small bottle. The next unit is a thousand of them—far too many for measuring medicine, or even for measuring butter. Halves, quarters, eights, and sixteenths, would have to be resorted to.

The metric system was devised by men who were quite ignorant of human needs and capabilities in such matters. The common man has a right to be heard and not to have his daily life meddled with by men who fail to think things through.

Pittsburgh, Pa. EDWARD GODFREY, M. Am. Soc. C.E.

Value of Life Membership

TO THE EDITOR: In the Secretary's office at Society Headquarters hangs a very fine portrait—a painting—of Past-President Desmond Fitzgerald, Hon. M. Am. Soc. C.E., whom I well remember.

At the time I was a member of the Board he wrote objecting in principle to the establishment of the proposed life membership class in the Society. His view was that he personally would prefer to continue supporting the Society by paying dues.

For a number of years I have thought of this point. My conclusion is that, in the long run, it is to the Society's interest to grant to long-time members the privilege of life membership. True enough, the Society thus loses their dues, and in the aggregate it is a large amount. On the other hand, this progressive policy has doubtless resulted in the Society's acquiring a large number of members and particularly in keeping members who might otherwise have dropped out.

It is a fact that our numbers have been maintained with remarkable continuity even during the depression. To my way of thinking, that is a commentary on the broad-minded policy pursued. My own feeling is that we have not greatly suffered financially and that we have gained immeasurably in good will and in an appreciative membership.

New York, N.Y. T. KENNARD THOMSON, M. Am. Soc. C.E.

Engineering in Latin America

TO THE EDITOR: In regard to Mr. Hogan's article on "The Future of American Engineers in South America," which appeared in the April issue, I am entirely in accord with the statement that it is difficult to generalize about a continent. I would be even more emphatic and say it is impossible. People—perhaps especially the people of the United States—fail to realize that, while the twenty republics of Latin America have many things in common, they also have many national differences, besides those of topography, climate, and terrain.

It is true, as Mr. Hogan says, that large developments of water power are topographically possible, but in most cases this would be at relatively high cost when delivered at points of use. The question of competition on a cost or price basis has to be considered. Low wages are not always synonymous with low cost of the finished product.

In the matter of transportation, it is true that during the past twenty-five years we have seen the development of motor vehicles and airplanes, but so far there is little to indicate that railways will not continue to be prime factors in transportation for commercial and agricultural development. Without them it is doubtful if the Allies would have been as successful as they have in their war effort.

I am afraid I cannot agree with the statement that South America is literally alive with railroad projects, though this may be true of Brazil as long as Uncle Sam continues to play Santa Claus. In general, people and governments tend to build highways with little regard for their economic utility, either first costs or maintenance costs. People with automobiles want roads on which to drive them. And though provision for recreation and pleasure is legitimate, these items should not be confused with economic commercial development.

That there is great need of sanitary engineering and sanitary works is beyond dispute. Provision of these facilities, however, should be combined with education in their proper uses, and this will require at least one generation. Furthermore, these works require capital investments, and there is not only lack of money but also lack of credit, except in Argentina and Venezuela. Many of the other countries borrowed money from the United States in the late 1920's, but have not repaid it. Since then they have been loaned more money by our government, and they have bought up and repatriated their defaulted bonds at the distress prices which these defaults have caused.

We ourselves have a staggering debt for the war. We need private capital for the rehabilitation of our own industries and for deferred maintenance, and we shall be called upon for a large share in the rehabilitation of the war-torn world. Where, then, is there to be found capital for new construction in Latin America, especially in view of the very bad credit record of so many of the countries?

At the moment many of these countries have dollar balances here, accumulated during the war. This money, however, they will probably use to buy both capital and consumer goods as soon as the war restrictions are removed and shipping facilities are available. For awhile there will be an active export market, but in most cases it will last only a short time. It should not deceive us and lead us to think that it means continued prosperity in Latin-American trade.

Mr. Hogan's comments on the Pan-American Highway reenforce my own point of view. Almost without exception the commerce and business of the countries of Latin America are from the interior to the coast for export of commodities and raw materials and from the coast to the interior for import of manufactured goods. The need for intercommunication between countries is very small and is well covered by air service. That the Pan-American Highway will develop good cultural relations and good business is doubtful. Even if we furnish the money to build the highway, the cost of maintenance is a burden that few of the countries can afford or will assume.

FRED LAVIS, M. Am. Soc. C.E.
New York, N.Y. *Consulting Engineer*

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

Herewith Dr. Mead gives his answer to Question No. 33, which was announced in the June number. The question reads as follows: "A young engineer working for a large manufacturing company has an opportunity to do some work outside his regular hours with the company. The work is not technical and is in no way connected with the company. Is the engineer justified in employing his spare time on such work?"

The writer believes that the young engineer is entirely justified in doing such outside work, provided that it in no way interferes with his regular work either by taking time which otherwise belongs to his regular employer or by so tiring him that he is unable to perform properly the work on which he is employed.

DANIEL W. MEAD, Past-President and
Madison, Wis. Hon. M. Am. Soc. C.E.

Question No. 34, which was announced in the July issue, will be answered in the forthcoming, or September, number. Next in the series, the following question is announced. Replies may be received until September 5, with answers in the October number.

QUESTION No. 35: *A university student, enrolled in the electrical engineering course, is offered part-time employment with one of the telephone companies associated with the A-system about a year before the time for him to graduate. The representative of the company tells the student that the company intends to help him through school by giving him employment during the following school year on a telegraph repeater maintenance job, and that after graduation it plans to put him in the engineering office as a repeater man. The work given him while in school is light and involves easy hours, and he gets well paid for doing it as it is of a special nature. He is benefited, and the A-company also receives full value for the service he has given while holding the job. After the student graduates and goes through the company's special six-week course in order to learn more about the repeater work, he is offered a good position with rather unusual opportunities in another company. Should he accept, or what should he do in this case?*

SOCIETY AFFAIRS

Official and Semi-Official

Nomination of W. W. Horner for President

WESLEY W. HORNER, Consulting Engineer of St. Louis, was nominated for President of the Society, 1946, at the recent meeting of the Nominating Committee. Mr. Horner is an especially well-known consultant, writer and educator, specializing in municipal, sanitary and hydraulic problems. His most recent writing for Society publications was the article in the April issue of CIVIL ENGINEERING on river valley authorities. In the preparation of this article he was co-author with President J. C. Stevens.

For over 25 years immediately following his graduation from Washington University, he served the City of St. Louis in varied municipal engineering work. A major project under his charge was the great Des Pères Drainage Project through the heart of the city. Another of his special responsibilities was the Oakland Express Highway. For about 15 years he was Chief Engineer of Design and Construction of Sewerage and Paving for the city.

Winner of the Rudolph Hering Medal in 1938, Mr. Horner has served as Director of District 14, as chairman of the Sanitary Engineering Division, and in various other capacities. At present he is on the Sanitary Division's Committee on Revision of Definition of Terms Used in Sewerage and Sewage Disposal Practice. He is also a Past-President of the St. Louis Section. His association with the Society dates back to 1908, when he was elected a Junior. He became an Associate Member in 1911, and a Member in 1917.

W. W. HORNER, NOMINEE FOR PRESIDENT, AM. SOC. C.E., DURING 1946

The nominee has been an expert consultant on many federal and regional projects, including the Interstate Committee on the Red River of the North; Board of Review, PWA; Soil Conservation Service; and flood control studies for the Department of Agriculture. His past experience has included the National Resources Planning Board's so-called "308 Reports," extensive work for St. Louis County, and drainage and sewerage problems, highway and airport planning throughout the Middle West.

For a number of years Mr. Horner served as Professor of Municipal and Sanitary Engineering at his alma mater, Washington University in St. Louis. His educational pursuits have also included the authorship of many papers and textbooks. He has contributed generously to the Society's PROCEEDINGS, especially on the subject of hydrology. Jointly with F. S. Flynt he received the Rudolph Hering Medal for the treatment of the subject, "Relation Between Rainfall and Runoff from Small Urban Areas," which appeared in TRANSACTIONS, Vol. 101. His varied contributions to CIVIL ENGINEERING have also been notable.

The nomination was made at the July 16 meeting in Detroit in accordance with the provision in the Constitution calling for such action before October 15. The next meeting of the Board could hardly be held in time to meet this deadline. A more extensive review of Mr. Horner's work will appear in a later issue.

Meeting of the Board of Direction, July 16–17, 1945—Secretary's Abstract

THE BOARD of Direction held its summer meeting at the Statler Hotel in Detroit, Mich., on July 16–17, 1945, with the following members present: President J. C. Stevens in the chair; Wm. N. Carey, Secretary; Past-President Black; Vice-Presidents Dougherty, Thomas, Howard and Polk; and Directors Bakenhus, Breed, Bryan, Critchlow, Dougherty, Edwards, Gamble, Gardiner, Goodrich, Hathaway, Hollister, Koch, Saville, Scobey, Shannon, Thomson, Tipton, Tolles, Wilson, and Treasurer Trout. Except for Past-President Whitman, who had to leave following the meeting of the Executive Committee on July 15, Board attendance was complete.

MEMORY OF SECRETARY SEABURY

The Board rose for a moment of silence in honor of the late Secretary George T. Seabury. Subsequently it authorized appointment of a committee to prepare a Society memoir.

Approval of Minutes

Minutes of the Board of Direction for April 16–17 were approved as previously submitted, with minor revisions. Minutes of the Executive Committee for April 15 were also approved. Report of the Executive Committee meeting of July 15 was presented in detail; actions with respect to it are incorporated in the following minutes as actions of the Board.

Local Section Constitutions

Amendments to the by-laws of the Nebraska Section and to the constitutions of the Mohawk-Hudson and Cleveland Sections were found to be in order and were approved.

Fall Meeting of the Board

It was determined that the fall meeting of the Board is to be held at the Palmer House, Chicago, Ill., on Monday and Tuesday, October 15 and 16, 1945.

Salary Survey

Authorization was given for some extension of the work on a salary survey in Maryland to be made by Allen P. Richmond, Jr., Assistant to the Secretary.

Postwar Construction

The status of the Society's Committee on Postwar Construction, and its relation to the work of the Action and Advisory Committee on Construction of the Committee for Economic Development, was referred to a special committee.

Assistant Secretary Confirmed

Appointment of James E. Jagger as permanent Assistant Secretary of the Society was voted. (See separate item in "Society Affairs" section.)

Cancellation of Military Dues

Provisions now in effect for the cancellation of dues of certain members in the military service were continued.

iety Fiscal Year

Upon recommendation of the Society's auditors and staff, it was ted that the Society's fiscal year should end September 30 in-ad of December 31. This arrangement, which goes into effect of September 30 next, concerns only the financial operations d does not affect the dues or publications subscription period.

trols Over Construction Industry

In connection with the Society's Committee on Postwar Con-uction, the Board received and commended a statement of a mittee of the Chamber of Commerce of the United States on onstruction Conversion Policy with Respect to Controls." tails of this statement appear in an item elsewhere in this issue.

minating Committee

It was reported to the Board that the Nominating Committee, lowing Constitutional procedure, had selected W. W. Horner of Louis as the official nominee for President in 1946, and that . Horner had accepted the nomination. A separate item ewhere in this issue gives further details.

leral Labor Relations Act

As a result of the report of the Washington representative, essary steps were taken looking toward safeguarding the iety's interest in the matter of the pending Federal Labor lations Act, designed to protect the rights of the professional ineer in collective bargaining.

ical Procedure

The Committee on Professional Conduct reported one case of a mber's activity conflicting with the Society's Code of Ethics. its recommendation the Board took appropriate action.

iety Membership

Action was taken on a number of cases with respect to applica-ns for membership in the Society, as presented by the Com-ttee on Membership Qualifications.

iversal Military Training

Resolution was adopted urging establishment of a system of iversal military training, to be harmonized with civilian training the basis of minimum interference with peacetime functions. rther implementing of this action was delegated to the Executive mmittee.

ernment Competition with Private Engineers

An extensive report was received from the Committee on Private gineering Practice and its subcommittees, particularly with regard to encroachment by governmental agencies. The Board voted that steps be taken to determine the extent of any present or proposed use of consultants by federal departments, the activities of teachers in private work, and details of specific experiences of private engineers as related to the general problem.

Collective Bargaining

Considerable discussion arose in regard to financial help to Local Sections in handling their problems of collective bargaining. This and other features of the general question were referred for disposition in detail to the Executive Committee in the light of the attitude of the Board as expressed in the full discussion.

Society Committees

On recommendation of the Executive Committee of the Structural Division, approval was given to the formation of a "Research Council on Bolted and Riveted Joints," the Society acting as sponsor.

Reports were received also on various other Society committees such as Honorary Membership, Division Activities, Society Relations, Securities, Private Engineering Practice, etc. Membership or representation on various committees was also determined.

Mileage on Society Work

The formula for computing reimbursement of travel expense for Society work in terms of a mileage formula was revised to accord more nearly with current costs.

Inter-American Cooperation

The Board approved action of the Joint Conference Committee in setting up under its organization a Joint Committee on "Inter-American Engineering Cooperation."

Appreciation

A vote of thanks was extended to those who facilitated the Board meetings—especially to the Michigan Section for its hospitality on Monday evening, July 16, to the Rackham Memorial for courtesy of inspection, and to the Statler Hotel for its excellent accommodations.

Other Matters

Various other items were reported for the record or were the subject of committee report without conclusive determination. Appropriate action was taken in each instance.

Adjournment

The Board adjourned at 5 p.m., July 17, to meet in Chicago, Ill., on Monday, October 15, 1945.

Memoirs of Deceased Members Available

ONE of the Society's functions is the preparation of the pro-sional memoirs of deceased members. In former years these moirs were published in PROCEEDINGS first and later collated inclusion in the annual volume of TRANSACTIONS. For a number years these professional records have appeared only in TRANS-TIONS, but the work of preparation is still a continuous one eading over the entire year. Small groups of memoirs are reprinted" from TRANSACTIONS at irregular intervals and copies supplied to families and friends. As a recurrent reminder of mutual interests, copies are also mailed to the member's university or college; and the list of memoirs awaiting publication in TRANSACTIONS is published in CIVIL ENGINEERING for any who may otherwise have missed an opportunity to receive their copies. A considerable accumulation of memoirs is now being collated for the 1945 TRANSACTIONS. The complete list is as follows, but paper restrictions may dictate how many of these can be included. In the meantime, single-copy preprints will be available on request to Society Headquarters while the supply lasts.

emiah Ahern	James Cowin	Paul Hansen	Charles Sterling Millard	Howard Earle Shaw, Jr.
es Pennell Anderson	Leonard Martin Cox	Clinton Lee Harris	Eugene Clare Miller	Gilman Walter Smith
sha Brown Baker	Clare Harmon Currie	Berthold Francis Hastings	William Johnston Mitchell	Howard Everett Smith
est Daniel Bean	Edouard Jean Bernard de Mey	James Raymond Head	Egbert Jessup Moore	Marion de Kalb Smith, Jr.
ul Leonard Bean	Luis Agustin Deliz	Maxwell Henry	John Patrick Myron	George Francis Sparhawk
es Wallace Beardsley	Herman Francois Doeleman	George Hewitt	David Leonard Neuman	George Philip Alexander Stape
lph Norman Begien	Thomas Linus Keith Donnelly	George Higgins	Joseph Pettis Newell	Allen Whitmore Stephens
lliam Ethelbert Belknap	Edward Brown Donohue	Fred Keating Hilt	Walter Henry Norris	Charles Henry Stevens
ward Franklin Berry	Carl E. Downing	John Benjamin Hittell	Russell Melvin Obert	Willard Wilberforce Stone
ane Francis Bixby	Max Harry Doyne	John Brewster Hodgen	Clifford Older	Merton Rogers Sumner
ul Alexander Blackwell	Samuel Morrison Ellsworth	Harry Hamilton Holton	David Kirk Orr	Charles Mason Talbert
rence Moore Blair	Frank Harvey Eno	Harold Walton Hudson	Arthur Edmund Owen	Frederick Quaas Teichert
rman Worcester Bowen	Charles Dorman Evans	Howard Chapin Ives	Archibald E. Palen	Charles Augustus Thanheiser
nk Joseph Boyle	Frederic Harold Fay	Martin Joachimson	Theodore Bissell Parker	Frank Ellsworth Trask
njamin Edward Briggs	Edwin Stanton Fickes	Frank Minitree Johnson	Harry Alfred Parr	Harry Edward Tyrrell
n Lawrence Brodie	Harold Chamberlayne Fiske	Frank Rhymal Judd	George Wellington Pickels	Thomas Utegaard
omas Byrnes Brogan	Louis Focht	Julius Kahn	John Richards Gray Pill	Joseph Palmer Wadhams
ert Marshall Brosius	Howard Lewis Francis	Winfield Scott King	Fred Ashley Pneuman	Henry Matson Waite
lter John Buchanan	Charles Brae Galvin	Frederic Arnold Kummer	Milton Allender Pyle	Elton David Walker
n Edward Bussell	James Madison Garrett	Frederick Charles Lohmann	Alfred Merritt Quick	Edward Everett Wall
ward Laramie Carpenter, Jr.	William Gerig	Moses Jerome Look	Aaron Israel Raisman	Herbert Kirkman Ward
derick Charles Carstarphen	Herbert Thurston Gerrish	Edward Resolved Mack	Frederick Hosea Richardson	Timothy Silas Williams
n Francis Coleman	Leslie Warren Goddard	James Alexander McFadden	Allan Townshend Ricketts	Merton Horatio Willis
rtimer E. Cooley	John Edwin Greiner	John Herbert McManus	Franklin Henry Robbins	Donald Witten
rles Robert Foran Coutlee	Lawrence Griffith	David White McNaugher	John McClure Salmon	Harold Aaron Wood

Relaxation of Controls on Construction Recommended

At the recent meeting of the Board of Direction in Detroit, a recommendation of the WPB's Construction Industry Advisory Group, and Construction and Civic Development Department Committee, was considered. The recommendation, which is here printed in full, was made on May 2 in Washington, D.C. The Secretary of the Society was directed to communicate the Board's commendation of the work to the WPB groups that drew up the recommendation.

CONSTRUCTION CONVERSION POLICY WITH RESPECT TO CONTROLS

Recommended Policy—Relax and Then Eliminate Controls

IT is the consensus of the construction industry, including finance and real estate interests, as well as designers, contractors, manufacturers and distributors, that construction controls should be relaxed as soon as practicable and then eliminated.

Recommended Steps to Carry Out This Policy

In carrying out this policy, the following recommendations have been developed as a result of many hours of conference discussion:

1. Firm agreement on this proposed construction conversion policy should be reached and working relations established for carrying it out cooperatively by and between the War Production Board, the Office of Price Administration, the Federal Reserve Board, the War Manpower Commission, the Office of War Mobilization and Reconversion, the Office of Defense Transportation, and any other government agency whose activities have a major bearing on the conversion of construction.

2. The War Production Board should take the initiative in bringing about this agreement on overall policy and these cooperative working relations. A liaison official should be designated and charged with this responsibility.

3. Steps should be taken to encourage as early provision as practicable of inventories of building materials and of mechanical equipment and machinery used in civilian construction, as follows:

(a) Rescind WPB orders which restrict manufacture and impose wartime specifications;

(b) Allocate adequate critical materials needed to manufacture or produce scarce and missing items;

(c) Permit manufacturers to utilize required materials and manpower for making of patterns, and reassembly of machinery and other production needs;

(d) Priorities assistance to building-product manufacturers to do the construction required to readapt or modernize buildings or construct additions or new buildings to provide needed capacity;

(e) Priorities assistance to building-product manufacturers to obtain additional machine tools or other production machinery;

(f) Relax as required the general inventory order to permit wholesalers and retailers to build up inventories to required volume.

4. Construction controls, during the transition period and until the end of the war, should be confined to war needs and those essential to the civilian economy.

5. Timely and authentic information should be provided the industry on the availability, currently and in prospect, of construction materials and equipment.

6. Price, rent and credit controls, manpower, and other wartime regulations of construction should be adjusted to facilitate this materials and equipment conversion program, and to insure prompt restoration of a free market after the war.

7. Encouragement should be given to advance "blueprinting" of needed construction, through authoritative announcements as early as practicable of the government's construction conversion policy.

8. There should be frequent conferences between federal government officials and responsible representatives of the various interests engaged in construction, including labor, contractors, home builders, architects, engineers, manufacturers, distributors and dealers, mortgage financing and real estate interests, and federal, state and local officials concerned with public works.

Members Appointed to New Posts in Bureau of Reclamation

APPOINTMENT of three assistant chief engineers of the U.S. Bureau of Reclamation was recently announced by Secretary of the Interior Harold L. Ickes. The three men who will assist Chief Engineer Walker R. Young in the Denver office of the Bureau are W. H. Nalder, chief of the civil engineering division; Ralph Lowry, chief of the construction division; and L. N. McClellan, chief of the electrical and mechanical division. Both Mr. Nalder and Mr. Lowry are members of the Society.

Creation of these three new posts is part of the Bureau's preparation for a broad postwar program aimed at full utilization of the land and water resources of the West. The Chief Engineer's office, which designed and supervised the construction of Boulder, Grand Coulee, and Shasta dams and numerous other great works, will also be responsible for the design and construction in the Bureau's expanded program. Designs and specifications are now being prepared for a large number of projects, on which construction can be started when war conditions permit.

THREE NEW ASSISTANT CHIEF ENGINEERS FOR THE BUREAU OF RECLAMATION

Left to Right: Ralph Lowry, Construction; L. N. McClellan, Electrical and Mechanical; and William H. Nalder, Civil

Commenting on the new appointments, Commissioner of Reclamation Harry W. Bashore said, "Each of the new assistant chiefs is an engineering specialist and an authority in his own field. Together, they form a team conversant with all phases of Reclamation work."

Mr. Nalder has been with the Bureau since 1909, serving in the capacity of assistant chief designing engineer from 1931 on. Entering government service in 1914, Mr. Lowry acted as resident engineer on various Bureau projects, and in 1935 he succeeded Walker R. Young as construction engineer. Mr. McClellan has been chief electrical engineer of the Bureau since 1925.

Committee to Aid Veterans Formed

Action Taken on Employment in the Construction Industry

DURING a conference of representatives of the construction industry on June 25, a "Committee on Opportunities for Veterans in the Construction Industry" was formed. Delegates from 21 organizations, brought together by the American Society of Civil Engineers, assisted in the formation of the Committee, and others will be asked to cooperate. First activity of the Committee will be the preparation of a handbook for veterans, explaining in detail opportunities in the construction industry and how they can best take advantage of those opportunities.

Stated at the conference was the probability that an annual volume of fifteen billion dollars' worth of construction of all kinds will be required if the construction industry is to carry its share in support of the national economy after the war. Contractors, architects, engineers, and manpower agencies of government are concerned with the possible delay in placing the construction industry in high gear immediately after V-J Day.

Twenty-one men, each an authority on some phase of the construction industry, attended the conference in Washington, D.C., to explore the opportunities in that industry which will be open for veterans. Consideration was given to measures that will help t

bring veterans into the industry in such a manner as to best serve the interests both of the job seekers and of the industry. Out of this meeting came a permanent Committee on Opportunities for Veterans in the Construction Industry with Day I. Okes, Assoc. M. Am. Soc. C.E., President of Okes Construction Company, St. Paul, Minn., as chairman; F. Stuart Fitzpatrick, Manager of the Construction and Civil Development Department of the U.S. Chamber of Commerce, as vice-chairman; and E. Lawrence Chandler, M. Am. Soc. C.E., Washington representative of the American Society of Civil Engineers, as secretary.

Handbook to Be Prepared

The Committee decided to prepare a handbook in form for distribution to veterans in their own communities after they have been discharged from the armed services. It is proposed that this publication be a well-rounded statement of opportunities for the veterans interested either in future technical education, in apprentice training for skilled crafts, in finding jobs, or in establishing their own businesses. It will direct the veterans to sources of information relative to assistance granted under the G. I. Bill of Rights and other legislation. A portion will be directed to employers and to educational institutions to indicate to them how they may cooperate in rehabilitating the industry. The expense of compilation will be carried by contributions from the organizations interested and it is expected that federal agencies will assist in publication and distribution.

A program of action at community level is planned by the Committee to accomplish its objectives. It is proposed that local committees be established, composed of representatives of the various branches of the construction field, and that these committees work in cooperation with veterans' representatives at U. S. Employment Service offices in the communities. A National Committee, whose membership will be drawn from organizations of the types represented on the Committee on Opportunities for Veterans in the Construction Industry, will formulate general policies for action, but details of procedure will be left to the local groups.

Close cooperation will be maintained with federal agencies charged with the duty of assisting veterans, in order that there may be no unnecessary duplication of effort.

Organizations cooperating in the work of the Committee are: American Association of State Highway Officials, American Federation of Labor, American Institute of Architects, American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Road Builders Association, American Society of Civil Engineers, American Society of Mechanical Engineers, Associated General Contractors, Association of American Railroads, Engineering News-Record, Engineering Societies Personnel Service, Society of American Military Engineers, Swarthmore College, U.S. Chamber of Commerce, University of Michigan, Veterans Administration, and War Manpower Commission.

Papers Filed in Engineering Societies Library

ADDITIONS have recently been made to the file of technical papers in the Engineering Societies Library. Many such papers, which contain valuable data but which, for one reason or another, have not been published, are available for inspection at the Library. If desired, photo prints can be obtained upon arrangement with the Library. Inquiries should be addressed to the Engineering Societies Library, 29 West 39th St., New York 18, N.Y. Following is a list of papers recently added to the file:

Structural Analysis

S. F. Borg, "Deformations and Redundants Determined by the Shear Area Method" (17 pages of text, plus charts and diagrams). By a simple manipulation of the shear area method, this paper indicates a ready solution for beam-column moments and deflections.

Flood Routing

William W. Anderson, "Flood Routing by Translation of Flood Wave" (10 pages of text, with several curves and tables). This paper sets forth a method of flood routing by tracing the movement of a flood wave downstream. Ohio River studies are used as illustrations.

Structural Analysis

Fang-Yin Tsai, "Truss Deflections by the Improved Method of Elastic Weights" (16 pages of text with diagrams). It is the object of this paper to simplify the computation of elastic weights for vertical deflections of truss members and to extend the method to the solution of horizontal deflection diagrams—also for trusses.

Soil Mechanics

F. M. Van Auken, "Determination of Pore-Water Pressures by Means of the Triaxial Compression Test" (13 pages of text, plus charts and curves). A laboratory method of determining pore-water pressures in cohesionless materials is presented along with a discussion of the application of the triaxial compression device as a means of determining those pressures.

Appointment of Assistant Secretary Confirmed

The appointment of James E. Jagger ("Ed" it is, in case you may be confused) as Assistant Secretary of the Society was confirmed by the Board of Direction at its Detroit meeting. Mr. Jagger, with whom many have become acquainted during his four years with the Society, was appointed to the post by Secretary Carey as one of his earliest official actions.

James E. Jagger, Assistant Secretary, Am. Soc. C.E.

Extensive knowledge of the needs of members of the Society was obtained by Mr. Jagger while he served as Field Secretary, covering all sections of the country. As opportunity arose, he was promoted to Acting Assistant Secretary, in which capacity he has served for over three years.

Although "Ed" came to the Society from the "deep South," he started his career in New England's water power industry. After graduation from Massachusetts Institute of Technology in 1924, he spent nearly two years with Stone and Webster, Inc., on hydroelectric developments in Georgia. Following two years with a consulting firm in Birmingham, he joined the staff of the Alabama Water Service Company in Birmingham, where he served as chief engineer, vice-president, and member of the board of directors.

This promotion probably will not bring Mr. Jagger new jobs—just more of them. Having been appointed as Acting Secretary, he carried the full responsibility of the Society's work during the interval following the death of Secretary Seabury.

Consultants for Work Abroad

NUMEROUS requests have been flowing in to Society Headquarters and to the office of the U.S. Department of Commerce for consultants to direct projects in foreign countries. The Society has cooperated with the Department of Commerce in furnishing the names of a number of firms. Engineering firms that are in a position to accept such assignments should communicate directly with the Construction Unit, U.S. Department of Commerce, giving full particulars.

Information requested includes: (1) the countries in which a firm might prefer to accept an assignment; (2) the special fields of qualifications; and (3) the maximum and minimum size of assignment (in dollars) they would be willing to undertake.

It is likely, in view of the tremendous programs of reconstruction and expansion to be undertaken throughout the world, that the demand for engineering services will be large. As the requests for services multiply, it is to be expected that a large range and variety of work will be involved.

The Engineer in Foreign Service

XXII. Iran Greets Texas

By STEPHEN R. MIDDLETON, ASSOC. M. AM. SOC. C.E.
CAPTAIN, CORPS OF ENGINEERS, U.S.A.

MY WORK here is pretty much an average cross-section of what it has always been—roads, streets, railroads, air strips, docks, and different kinds of odds and ends such as swimming pools, material and equipment dumps, plants of one kind and another, buildings, and even raising sunken cargo barges. None of it is particularly unusual except maybe our so-called "pavements." They are made of just plain desert dirt and oil. It's about like MC-2 on the average, but no two barge loads are quite alike. The desert dirt is A-6 to A-7 in characteristics—not much different from the dirt you have around there, except it's gray instead of black—and we can get away with this makeshift asphalt stabilization only because of the unusually dry climate. The stuff is as hard as rock as long as you can keep it dry.

We have plenty of heavy equipment and are able to put up dirt work the way it should be put up. A couple of inches of the subgrade is scarified and bladed up, pulverized dry with sheepsfoot rollers, then mixed with 7 to 8% of this asphalt I mention, bladed thoroughly to insure good mixing and aeration, spread back out on a thin tack coat, rolled with pneumatic rollers, and finally sealed with about 0.2 gal of asphalt and a good dusting of dry desert soil. We have a little pea gravel which we use for sealing an occasional section we feel, for one reason or another, will last longer than average.

For mixing the asphalt into the pulverized soil that later forms the 2-in. mat, we use wood mixers or distributors and blades—either way takes about the same length of time. You can run a wood mixer over a windrow pretty fast, but you still have to blade it a lot before it's any good. We have found that good pulverization and plenty of blading are the most important factors leading to good results. Field behavior and lab. tests with an improvised Hveem stabilometer both bear this out. Exactness in the per cent of asphalt is of less importance. We have also tried thinner pavements, down to about 1 in., and thicker ones up to about 5 in., but finally decided that around 2 in. was best. Thinner ones break up, particularly along the edges; and a well-constructed 2-in. pavement seems to last about as long as a thicker one, with less tendency toward instability.

There are no load limits around here—they just pile on all they can and give her the gun. It's a pretty rough proposition—but even so, the pavements last up to 9 or 10 months in some cases without reworking. On the other hand, we have to rework some sections every 3 or 4 months. This oil is the only thing plentiful around here—there is no sand or gravel—so we have little choice except to keep on doing as we are doing. I am sure that the dry climate alone makes the thing feasible at all—and if there were much rainfall we couldn't get away with it—for runways, richer and thicker mats are used of course.

Not long ago I took a Sunday off and went up North a way and had a fine hunt. We got, among a sack full of lesser game, one wolf and the biggest wild boar I have seen so far. He weighed about 400 pounds and looked as big as a cow—tusks about like this fountain pen—a very uninviting looking critter, I can tell you. We also took a shot at some kind of a cat, about half as big as a Mexican lion, but missed him and he scatted. I kinda wanted that cat too. It was a long tiresome trip, with only four hours of hunting before turning back for home—but it was worth it.

I have to fly now and then, and from the air you can see that in some bygone age this desert was cultivated and had lots of things on it that are not there now. From high enough up, the faint traces of an elaborate system of irrigation canals and other improvements are plain to see; confirming the stories and legends of that time the Persians still tell. This goes northward up the country for maybe 150 miles—and how far east and west I do not know—except that the Tigris and Euphrates valleys are also full of it. On the ground all of it looks alike and there is nothing there but miles and miles of miles and miles—but once, some time in the past, this was a good country.

Not long ago I had occasion to fly over the old city of Shushtar, which is supposed to be the ancient capitol, Shushan, that is mentioned so often in the Book of Esther in the Old Testament. Most Middle East cities look from the air about the same as from the ground—not very interesting—just a bunch of baked mud one-story houses with flat roofs—but this Shushtar is different; as pretty and interesting a place from the air as you could hope to see. On one side is a river; on another are mountains that rise on up and disappear into snow and clouds, and on the remaining two sides deep rolling meadows stretch away for miles before the land gets rough and barren again. Shushtar itself is on a rough rocky piece of ground, and many stone masonry arches carry the streets across gullies and crevices that are everywhere. Persians live there now of course, but there are many ruins of old temples, mosques, walls that were once probably used for defense, and other things. Over the river about half of what was once a magnificent bridge still stands—stone masonry arches that look to be maybe 50 ft high with a roadway width of perhaps 30 ft. In the age when it was built, it was no doubt really something!

On the meadows to the east and south, there were herds of goats, horses, camels and water buffalo, and flocks of sheep. And leading northward a camel trail winds along the face of a cliff where the river comes out of the mountains—maybe ten or fifteen miles upgrade all the time, to the higher country that is beyond. We flew along there, and around over the city, and really took it in. It would surely be nice to visit that place on the ground, but it's so much trouble to get to it that way that there's not much chance.

(From letter to George B. Finley, Assoc. M. Am. Soc. C.E., published in "The Texas Engineer," publication of the Society's Texas Section, May 1945.)

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XXIII. Traffic Problems on the Western Front

By CAPT. W. K. STROMQUIST
(SON OF W. G. STROMQUIST, M. AM. SOC. C.E., PRINCIPAL SANITARY ENGINEER, TVA)

I'D better bring up some of the amusing incidents that occurred in the course of running the pick-up and delivery service that was one of the side lines. At one time or another we sent out all over hell and forty acres—at every hour of the day and night—to get everything from portable airfields to fur coats, and the only time I ever saw anybody bat an eye was the morning I told Sgt. Wooster to pick up a mixed load of coal and snow camouflage suits.

Pfc. Pool was always our hard-luck driver, cinching his reputation the day he had eight flat tires on one trip. One time somebody skidded into him at an icy intersection and bent up his steering gear. There weren't any spare parts right then, but we were too busy to quit using the truck on account of a minor fault—and it became known as "The Truck That Will Only Turn to the Left." Pool could make a complicated maneuver at intersections, resulting in a right turn, but the MP's controlling traffic didn't seem to appreciate the humor of the situation. And Pool nearly got tossed into the jug by a Colonel who, when he directed him to a parking area on the right side of the road to let a convoy pass, naturally thought he was just being stubborn when he parked on the left. Pool got around that way for quite awhile, but he nearly blew his top trying to figure out ways and means to get home again without any forty-mile detours en route. One day when Pool saw a truck get its back messed up in an accident, he waited until the driver went to get a wrecker and then got the parts he needed off the damaged truck before the driver could get back.

On a blackout trip Pool couldn't see very well through the windshield, so he opened the door and drove hanging out the side of the cab. All of a sudden the truck hit a deep chuck hole, pitching Pool out into thin air, and kept on going, fed by the hand throttle and guided by the deep ruts of the road. The driver of the following jeep didn't even know anything was wrong until he heard Pool sloshing through the mud, chasing his own truck and shouting, "Wait for me."

Another dark night, when you couldn't even find your face with both hands, Pfc. Smith was out feeling his way down the road in a jeep. He was following a tank, which makes a lot of noise, and judging by the sound he figured he was about fifty feet behind it. Going up a long hill, his motor started laboring and didn't seem to have much pep even in low gear (which he was using, because he was going so slow anyway). All of a sudden the tank backfired, and Smith found that he'd run right up against the tank and had been practically pushing it all the way up the hill.

(Reprinted from the July 1945 "Tennessee Valley Engineer," where it appeared as abstracted from the "Set Up," publication of the TVA Maps and Surveys Division.)

Appointments of Society Representatives

CHARLES A. ELLIS, S. C. HOLLISTER, and BRUCE JOHNSTON, Members Am. Soc. C.E., have been appointed the Society's representatives on the newly established Column Research Council of the Engineering Foundation.

News of Local Sections

Recent Activities

BUFFALO SECTION

Through the courtesy of Lt. Col. N. J. Riebe, of the U.S. Engineer Office at Buffalo, members of the Section had the pleasure of holding their June meeting aboard the dredges "Taylor" and "Savannah." Members were divided into two groups, one for each ship. Each dredge is equipped with two suction pipes, with especially designed drags (one each on the port and starboard sides), through which the dredged material is pumped aboard into hoppers with hinged drop bottoms for dumping the load. Used for maintenance work, this type of dredge is suitable for removing various materials up to 6 in. in diameter. As part of the regular maintenance program, each dredge picked up a load and carried it to the dump ground in Lake Erie, just south of the Bethlehem Steel Company's plant.

CENTRAL OHIO SECTION

Part of the May 24 meeting of the Central Ohio Section was devoted to business discussion. Then L. E. Vandegrift, design engineer for the Bureau of Bridges of the Ohio State Highway Department, presented a paper entitled "Vibration Studies of Continuous Span Bridges." Considerable discussion followed his remarks, and it was announced that Mr. Vandegrift's researches have been published as a bulletin of the Engineering Experiment Station at Ohio State University.

COLORADO SECTION

A number of the University of Colorado Student Chapter members taking the V-12 training course were guests of the Colorado Section for its May 14 meeting. The list of speakers for the occasion included Fred A. Armstrong, who described his experiences building water systems for airports in India, where he was with the Army Engineers; Royce J. Tipton, Society Director from District 16, who gave a résumé of the Board of Direction's spring meeting in Chicago; and Ernest Wahlstrom, professor of geology at the University of Colorado, who gave an illustrated lecture on the geology of the proposed Blue River diversion tunnel.

DISTRICT OF COLUMBIA SECTION

The District of Columbia Section held its June meeting at the Timber Engineering Company Laboratory, where research experiments in wood technology, chemical and structural, were demonstrated by the staff. Following a buffet repast, President B. E. Jones welcomed the group of 175, one of the largest attendances at a regular meeting of the Section, and introduced three members of the laboratory staff who explained the work under way. Dr. Eduard Farber, chief chemist, described the Scholler process for extracting ethyl alcohol from sawdust; J. L. Stearns, shop superintendent, covered the fields of experimentation in product development, such as abrasion testing and toughness rating; and Everett S. Lank, Teco structural engineer, spoke on the Teco connector test program, its methods and aims. Following these brief talks, the laboratory was put in full operation and all equipment demonstrated.

FLORIDA SECTION

The June meeting of the Florida Section took the form of a joint session with the Society of American Military Engineers and the Engineering Professions Club of Jacksonville. Guests of the group included the officers of various civic organizations of Jacksonville. The technical program for the occasion consisted of a talk by Col. A. B. Jones, district engineer of Jacksonville, who discussed "The Current Civil Works Program of the Corps of Engineers in Florida." Some of the twenty-five postwar projects that are to be undertaken in Florida are the Intra-coastal Waterway from Jacksonville to Miami, the Cross-Florida Barge Canal, and the Virginia Key Project at Miami. Colonel Jones stated that while the appropriations bill authorizing the Florida postwar projects stipulates that work cannot start until six months after the war, plans and specifications are already being prepared, so that work can be started as soon as approval is given. It is estimated that the projects will cost more than $100,000,000.

HAWAII SECTION

On June 4 the Hawaii Section held its third technical meeting of the calendar year. On this occasion the group heard H. K. Bishop, deputy commissioner for the Public Roads Administration, discuss the development of that organization from a very modest beginning to the prominent position it occupies in the road building of today. In the discussion that followed from the floor, he described the development of various types of road. During the business session Simon Perliter was elected to the office of president of the Section to fill the unexpired term of Comdr. Leslie Watson, who recently resigned.

ILLINOIS SECTION

At a special dinner meeting of the Section, held in Chicago on June 13, E. J. Kelly gave a talk on "Engineers I Have Known." Mr. Kelly, long-time mayor of Chicago, discussed his early engineering experiences, commenting particularly on the engineers who were active in the early part of the century in the construction of the Sanitary Canal and other local engineering structures. Representatives of several other engineering organizations in the Chicago area were guests of the Section.

ITHACA SECTION

The regular May meeting was held in conjunction with sessions of the New York State Society of Professional Engineers, the Southern Tier Technical Society, and the American Chemical Society in Binghamton, N.Y., on the 23d. The after-dinner speaker was Dr. L. F. Livingston, manager of the Agricultural Extension Division of the E. I. Du Pont Company, who discussed the subject of engineering research. On May 29 Waldo Bowman, editor of *Engineering News-Record*, spoke to the Section on "Military Engineering in the European Theater."

KANSAS SECTION

Numerous business matters were discussed at the May meeting of the Kansas Section, which took place in Topeka on the 11th. The Section went on record as favoring that registered engineers in state employment be recognized as engineers on the basis of their registration rather than on the basis of Civil Service examinations. During the evening it was announced that Robert Forest Kenny, who will graduate from the University of Kansas in the summer of 1945, has been selected as the outstanding civil engineering student from that school and awarded the Section's annual prize of Junior membership in the Society. A talk on "Engineering in Hawaii"—given by Earl Bradley, of the Kansas State Highway Department—comprised the technical program.

LOUISIANA SECTION

On June 25 there was a joint meeting of the Section and the Louisiana post of the Society of American Military Engineers. The Section's Committee on Awards recommended that Louis F. Guilbeau, of Opelousas, La., be awarded the Section's scholarship to Louisiana State University for the 1945–1946 school year. The Society of American Military Engineers was in charge of the technical program, which consisted of a talk by Brig. Gen. Max C. Tyler, of the Corps of Engineers, U.S. Army. General Tyler spoke on the subject, "The Flood Control Projects Below Old River," illustrating his remarks with stereopticon slides.

NEBRASKA SECTION

The principal speaker at the June dinner meeting of the Section—held in Lincoln on the 5th—was Roy M. Green, newly appointed dean of engineering at the University of Nebraska. Dean Green presented data obtained in a recent survey of engineering education, which was conducted by sending questionnaires to graduates of several engineering courses. It was found that a representative group attached great importance to English, the social sciences, and mathematical, mechanical, and structural

fundamentals. A striking similarity was observed in the opinions expressed by civil engineers, agricultural engineers, and architects.

New Mexico Section

"The Economic Future of New Mexico" was discussed by E. L. Moulton at the May meeting of the Section, which took place in Albuquerque on the 24th. Mr. Moulton, who is chairman of the research committee of the Committe for Economic Development, emphasized the necessity of developing small manufacturing concerns. Only in this way, he stated, can any sizable portion of New Mexico's idle labor force be employed. It was the unanimous opinion of those present that the session was an unusually informative one.

Oklahoma Section

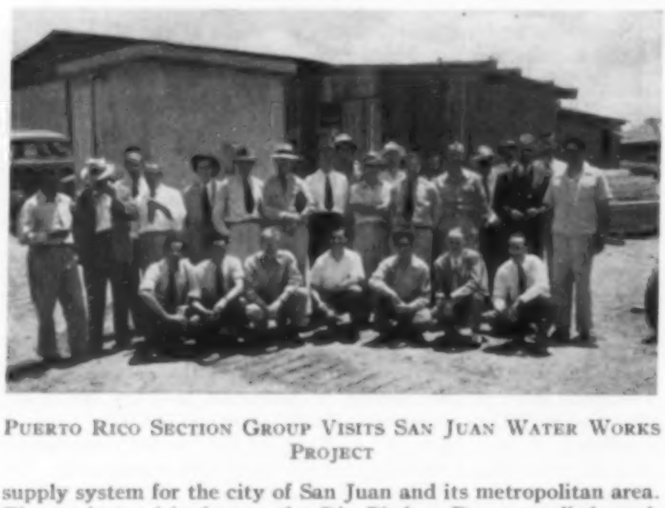
On June 16 members of the Section met in Oklahoma City for a business and technical session. The principal speaker on the technical program was Raymond E. Means, associate professor of architecture at the Oklahoma Agricultural and Mechanical College, who presented an interesting paper on "Building Foundations on Compressible Soils." During the evening it was announced that Jack Jacobi Coe, of the University of Oklahoma, is one of the recipients of the Section's annual prize of Junior membership in the Society. Later an outstanding senior at the Oklahoma Agricultural and Mechanical College will be selected for a similar award.

Oregon Section

At a meeting held in Portland on May 31, members of the Section heard two members of the Oregon State College staff—Fred Merryfield, professor of sanitary engineering, and R. E. Dimick, head of the department of fish and game management. The former revealed results of a study of the sanitary condition of a number of Oregon's streams from the standpoint of pollution. Methods of testing the stream, sampling, laboratory analysis, and correlation of data were discussed, and graphs showing the variations in pollution at various points were displayed. Mr. Dimick then described the habits of the various species of fish in the Oregon streams and discussed the effects of pollution upon the different species.

Puerto Rico Section

As a part of its June meeting, the Puerto Rico Section made a field trip to inspect the various projects comprising the new water



PUERTO RICO SECTION GROUP VISITS SAN JUAN WATER WORKS PROJECT

supply system for the city of San Juan and its metropolitan area. The projects visited were the Rio Piedras Dam, a rolled earth structure forming a storage reservoir of 336 million gallons of water (at this dam a morning-glory type of spillway has been constructed); a series of bridges, the highest of which rises 80 ft above the existing creek; and the Cidra Dam, a concrete structure 70 ft high, impounding 1,800 million gallons of water. The total system will supply the San Juan area with a minimum of 30 mgd of potable water. About 35 members and their guests made the trip. Making allowances for the distance to be traveled and gas rationing, this was a good attendance.

Panama Section

On June 4 Robert L. Tracy addressed an evening meeting on the subject of the Cucaracha Foundation Bearing Test currently being conducted in the Pedro Miguel Locks area. The test structure, a 40 by 50-ft concrete slab loaded with 20,000 tons of steel plates and concrete blocks, is probably the largest structure in the world developed particularly for the purpose of obtaining controlled physical measurements of foundation settlement and reaction. The problems caused by the Cucaracha formation in the construction of the Panama Canal have given local engineers a profound respect for its temperamental character. However, the current test upon a large bearing area is of sufficient scale to give hope that its data are applicable to the design of large structures upon this material. Mr. Tracy is in the Special Engineering Division of the Panama Canal.

Sacramento Section

An interpretation of the San Francisco Conference was presented at the meeting on June 12 by Prof. Michael J. Brickley, of Sacramento College. At its 1,099th meeting, the Sacramento Section played host to J. C. Stevens, President of the Society, whose topic was "Know Your Society." President Stevens discussed the activities of some special non-technical committees of the Society and concluded with a Shakespearean recitation.

San Francisco Section

On June 19 President Stevens attended a regular dinner meeting of the San Francisco Section and spoke again on the subject "Know Your Society." A meeting of the Junior Forum of the Section, which took place on May 24, was attended by 36 Juniors. On this occasion David Pirtz, a member of the Forum, presented a paper on "The Testing of Airport Concrete Pavements Under Heavy Moving Loads." Mr. Pirtz is with the Pacific Gas and Electric Company. A sound motion picture on the story of aluminum concluded the program.

Tennessee Valley Section

The annual spring meeting of the Section was held at the University of Tennessee in Knoxville on June 9, with 116 in attendance. N. W. Dougherty, Director of the Society and dean of engineering at the University of Tennessee, greeted the group in behalf of the University, while C. E. Blee extended a welcome on behalf of the Knoxville Sub-Section, of which he is vice-president. The list of guests included Dr. James D. Hoskins, president of the University, who spoke briefly on the importance of teaching fundamentals in elementary and high schools. Scheduled speakers for the morning session were Oscar King, chairman of the Society's Committee on Postwar Construction, who discussed the activities of the committee; Ira C. Evans, regional manager of the Committee for Economic Development at Atlanta, Ga., who gave a résumé of the work of that committee; Hal H. Hale, executive secretary of the American Association of State Highway Officials, who spoke briefly on postwar highway planning; and L. A. Schmidt and W. F. Moehlman, chairmen, respectively, of the Postwar Planning Committees of the Chattanooga and Knoxville Sub-Sections, who reported on the activities of their respective committees. Following luncheon at the University of Tennessee cafeteria, the group enjoyed an inspection trip to the plant of the Fulton Sylphon Company.

West Virginia Section

At a dinner meeting, held in Morgantown on May 4, G. H. Bayles addressed the group on the subject, "By-Products of Engineering Practice." Mr. Bayles, who has been serving as construction superintendent for the J. G. White Engineering Corporation at Aruba, N.W.I., recounted personal experiences in various parts of the world and described some of the countries he has visited—from Brazil and Mexico in this hemisphere to Macedonia and Egypt in the Old World.

Wisconsin Section

A committee of Juniors, headed by E. J. Duszinski, arranged the program presented at the June 28 meeting of the Section. The speaker of the evening was Osborne M. Saxton, district manager of the Chicago office of Timber Structures Inc., who described recently developed processes of prefabricating timber for use in trusses, barges, and many other types of structures. His talk was followed by a motion picture, which showed various steps from the actual logging and sawmill work through fabrication and on to the field erection.

ITEMS OF INTEREST

About Engineers and Engineering

Ancient Chain Suspension Bridge in China

By Louis Young Dawson, Jr., M. Am. Soc. C.E.

Lieutenant Colonel, Corps of Engineers; Former Commanding Officer, Burma Road Engineers

The famous old trade routes between India and China ran through some of the most rugged country in the world, and there were many deep, wide, and swift mountain streams that had to be crossed. The Chinese solved the problem with an ingenious type of chain suspension bridge which could be built by local artisans.

The mountains, some reaching 18,000 ft in elevation, contain every type of soil known to man. They are new geologically, and earthquakes are frequent. Bridges were located where there was rock on both sides of the stream. The approaches are ledges cut in the rock. The presence of rock simplified the abutment foundation and anchorage problems, and also furnished materials for the construction of the abutments. These bridges, built years ago for pack trains and foot passengers, are still in an excellent state of preservation. While they apparently follow a "rule of thumb," you may be sure that some able and ingenious engineer designed them.

In general, a suspension bridge of this type consists of 8 to 12 wrought-iron chains directly supporting a roadway. Upon these chains wooden planks were placed crosswise, and a wooden walkway constructed on top of the cross planking. In addition to the chains supporting the floor, one chain was placed on each side of the bridge, about one meter above the floor, as a guard rail. At each end of the bridge is a head house; this protects the anchorage from the weather, and may or may not have been used to collect tolls.

Excellent Masonry in Abutments

Abutments are of stone masonry with double walls. The individual blocks were hand cut at the site from whatever type of rock was excavated for the road. So accurate was the cutting of these blocks that very little mortar was needed and the joints were almost "buttered." The mortar was made of lime, prepared locally in very crude kilns. Any type of earth adjacent to the site was used for fine aggregate. So excellent was the work that after all their years of service, the abutments show no sign of deterioration or of underscouring.

Local blacksmiths made the suspension chains at the site. Each link was hand made of wrought iron with lap welds. The iron varied in diameter, but averaged about an inch, and the length of the links varied from $9^1/_2$ to 13 in. The grade of wrought iron was excellent, for there has been practically no deterioration from rust.

The technique of stressing the cables and pulling them into place was quite unusual. Back of the anchorages to which the cables were being fastened, a hole about 30 in. in diameter and 4 ft deep was carefully driven into the rock. Into this hole was inserted a log, the top end of which had handles driven into it so that it could be used as a capstan. The cables were then pulled into position by sheer manpower with this crude capstan (Fig. 1). Yet a bridge so built not only stood the load for which it was designed, but has taken the even heavier loads that modern times have imposed.

Chain Bridge Over the Shen Pi River, China

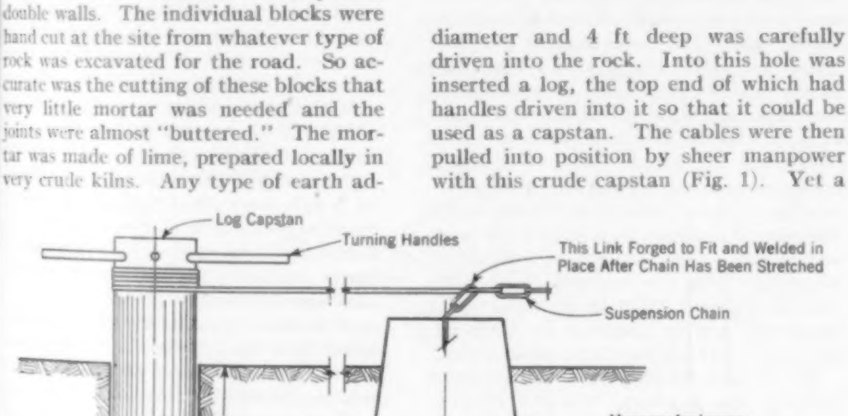


Fig. 1. Detail of Method of Applying Original Tension to Chains

The method of erecting these bridges is extremely interesting and shows great ingenuity. The abutments and anchorages were built first, and the anchors for the chains installed. The chains were then fastened to one anchorage and pulled across the stream as has been described. When each one had the correct amount of sag, it was held in place with manpower by the capstan, while the local blacksmith on the job made a link of the necessary length to fasten the chain to the other anchorage.

Upon completion of the floor system, the chains were carefully checked to see that each was the same length and had the same amount of sag. Any differences were adjusted by taking the shortest length as the correct one and adjusting the other chains to it. The differences were taken up by wedges driven between the links adjacent to the two anchorages.

The existing chain suspension bridge over the Shen Pi River, adjacent to the Burma Road, is typical of all the chain bridges observed. There are eight wrought-iron chains carrying the floor system. This seems to be the minimum number used. The two wrought-iron chains used as handrails carry no load whatsoever. The floor-system chains have a 3-ft 8-in. sag on a span of 100 ft 10 in. The maximum spacing of the floor-system chains is 1 ft 6 in., but the average is 1 ft 1 in., which is approximately a Chinese foot.

Chain suspension bridges of 200-ft span are known to exist. The design is similar, except that there are 12 wrought-iron chains in the floor system. Sometimes there are several spans supported by masonry piers in the center. The floor system consists of 2-in. planks of various widths fastened to the chains with staples. On top of these planks in the center of the bridge is a runway composed of five 2-in. by 8-in. planks fastened with hand-wrought nails to the cross planking.

The head houses are one-story buildings with mud-brick plastered walls, wood roof framing, and tile roofs. There is one building at each end of the bridge. These buildings were probably used originally for the collection of tolls and for shelter from the elements.

N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

Sir V. Ayer, Esq.
Esseyeville, U.S.A.
Dear Vic:

I've just enjoyed a stupendous furlough, thanks to you. After 10 days of the peace and quiet of Wahoo, O., I heard our

Wahooligan Band marching right up our street. I went out to the gate to watch them swing by to the tune of "Conquering Hero" and someone grabbed me and whisked me into the Mayor's car. The Judge and the Mayor yelled at me, but the band drowned them out. We followed the band right up Main Street, the whole town lining the curbs and bright new banners stretched overhead.

I read the banners: WAHOO WELCOMES ENGINEER HERO; DAYDE THE GENIUS OF GARNICHTSBURG; WAHOO BOY OUTDOES CAESAR IN FOG; WELCOME HOME, AL E. DAYDE.

I was stunned, but somehow I enjoyed being stunned. That is, until the parade closed up at the Wahoohio Hotel, and the band shushed, and the Mayor bragged for 30 min, and ended with the appalling command, "Now, Al, tell your good fellow Wahoovians how you steered your bridge across the Rhine in a fog."

Well, Vic, I couldn't let them down by saying I did it with strings. I told them frankly that I "funiculated a semi-coincident pair of complete quadrilaterals, adapting the principle that each of the three diagonals was divided harmonically by the other two." The crowd cheered. Ask Barnum why.

Later my old math teacher dropped in and asked to be shown. I drew him this sketch [Fig. 1] of lines we taped on the ground, stretching to make the lines straight. We taped in this order: *AC, BD, EfC, EBg, BC, FhG, AHi, AF, GIj, JEbridge*, where lower-case letters indicate new points intersected. He scaled off

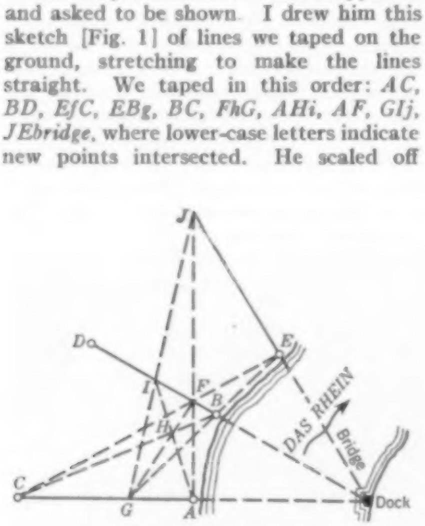


FIG. 1. HOW DAYDE DID IT

3,000 yd of tape we had used and thot it expensive. Somehow I couldn't tell him how fast the Joes were dropping and how many more might have dropped if we had missed the dock by 50 ft.

Then he confessed he read in the big city papers how you told the story to the Engineers Club and how he told the Mayor and that's how the parade started.

So I blame you, Vic, for my having to make a speech, but I've had a grand time ever since. The Wahoodlums look at me with awe, the Wahoolas are giving me a rush, and we don't talk about quadrilaterals.

Yours, Al

"Noah, I think Al's letter is the best answer to the problem you let me propound last June."

"Thanks, Sir V. The construction is clear and the proof should be easy after Al's statement of the principle. Now for a tussle with a barrel of beer, which Seabees C. Black and C. Brown found upended on the dock at Cebu.

"They hitched the middle of a rope to the east side of the cask, wrapped each running end around a quadrant and pulled west on the rope, which was then U-shaped with a Seabee on each end. Dragging the barrel was hard, hot work. Then Brown had an idea. He pulled alone for a few feet, then Black pulled alone. They claimed this scheme was easier, so they polkaed the keg to the canteen. Could they be right?"

New in Education~

Correspondence Course for Former Students

THE MICHIGAN College of Mining and Technology, Houghton, has established a correspondence-course program intended primarily for former students, especially those in the armed services. It will consist of 60 courses. One-fourth are noncredit refresher courses; the rest carry credit. They are offered by nearly all departments, both service and degree-granting. It is expected that correspondence instruction will begin in many of the courses early in the fall.

* * * *

Yale Announces Traffic Engineering Fellowships

TEN Graduate Fellowships in Traffic Engineering are announced by the Bureau of Highway Traffic of Yale University. These amount to $1,400 each and provide for a full academic year of graduate study beginning October 1, 1945.

The regular course of graduate training in traffic engineering is being resumed at Yale this fall for the first time since Pearl Harbor. Mr. T. M. Matson, Director of the Yale Bureau of Highway Traffic, in announcing the availability of fellowships, stated that, "The resumption of graduate training in traffic engineering is especially timely in view of the acute street and highway transportation problems which now exist and which will grow worse as travel restrictions are lifted. Matters of traffic operations are being given increased attention by state and municipal officials in the planning of roadway facilities for the postwar period. The courses of instruction offered at Yale are designed to give the student skill and ability in analyzing traffic conditions and in planning for their improvement in both rural and urban areas."

Enrollment will be limited to 35 students meeting the graduate training requirements of the Bureau. "In addition to recipients of fellowships, the course is open to returning veterans under the provision of the G.I. Bill of Rights," said Mr. Matson. "It is also expected that there will be students from city engineering and state highway departments who will enroll either on their own, or with some financial support made possible through special assignment by their employers."

The ten fellowships have been made possible through a grant to the Bureau of Highway Traffic from the Automotive Safety Foundation. Additional information concerning the course and fellowships may be obtained by writing to the Bureau of Highway Traffic, Yale University, New Haven, Conn.

* * * *

Stevens Engineering Camp Reopens

THE Stevens Engineering Camp at Johnsonburg, N.J., closed since 1942 because of the war, reopened July 9 for six weeks of intensive instruction. Eighty men from Stevens Institute of Technology are attending, studying surveying and related subjects. Freshmen admitted to Stevens last July, November, or March constituting the class of 1948, make up the enrollment.

Most of the men will return to the campus after completing the camp course to continue their regular peacetime college curriculum. Others are attending the camp to obtain credit toward their postwar education and to develop some technical skill before entering the armed services.

The camp session is under the direction of Prof. Ralph O. Vuilleumier, Assistant Professor of Mechanical Engineering at Stevens. The reopening of the camp further marks the return of the college to peacetime operations. In July 1944, Stevens resumed its freshman instruction under the regular curriculum as it was prior to modification to meet war needs, at the same time continuing to provide training under the Navy V-12 program.

Directory of Research Laboratories in the United States

COMPILATION of the eighth edition of the National Research Council directory of industrial research laboratories in the United States is now under way. The seventh edition, which appeared in 1940, contained information concerning the industrial research laboratories of 2,264 companies and their subsidiaries.

With five years intervening between the editions, it is expected that there will be a number of changes and it is hoped that a number of new laboratories will be added. Although every effort was made in 1940 to reach as many laboratories as possible, no doubt some in each field were inadvertently omitted. For this reason, research men should inquire of the directors of their laboratories whether their questionnaires have been received, as those reporting in 1940 will have had their printed statements sent for revision.

If no questionnaire has been received, one will be sent upon request to the Library, National Research Council, 2101 Constitution Avenue, Washington 25, D.C. There is no charge for the inclusion of a statement regarding a laboratory in the publication, and no obligation is incurred in furnishing data.

U.S. Public Health Service Issues Report

The U.S. Public Health Service has issued two mimeographed reports—"Census of Sewer Systems and Sewage Treatment Plants in the Continental United States" and "Water Treatment Plants in the Continental United States."

In February 1939 the Service, with the cooperation of the state health departments, undertook a nation-wide census of public and semi-public sewerage facilities and water treatment plants in the continental United States. Subsequent changes in the directories are presented in the form of annual supplements, of which the current volumes (consisting of additions and revisions for 1943) comprise the third.

The data upon which the tabulations are based were furnished by the sanitary engineering divisions of the state health departments. Draft tabulations prepared by the U.S. Public Health Service at the Cincinnati station were submitted for state review prior to mimeographing final tables.

Semi-Centennial Observed by Fort Pitt Bridge Works

To celebrate its recent semi-centennial, the Fort Pitt Bridge Works has issued an illustrated booklet, entitled "Fort Pitt Bridge Works—50 Years of Progress in Steel Construction."

The foreword states, "As you turn the following pages a pictorial history of true American initiative, ingenuity, and industrial aggressiveness unfolds into a graphic realization of fifty years of progress in structural steel construction. It is also the story of three outstanding Pittsburghers, Theodore A. Straub, H. R. Blickle, and Paul B. Straub, . . . who foresaw the present industrial expansion, with the resulting demand for larger, safer, and more modern bridges and buildings."

Over the years, the fabrication and erection of a large number of Pittsburgh's famous bridges—there are more than five hundred of them—have been entrusted to the Fort Pitt organization. The company's war work has included the fabrication of materials for LST ships and for tankers, and the development of the 36-ft hydraulic press for a speedy and accurate method of forming tanker bulkhead plates.

Stream Improvement Week

August 13 to 20 has been proclaimed Stream Improvement Week in Indiana by Governor Ralph F. Gates. In an effort to direct attention to the necessity for eliminating pollution from the streams of the State, the Governor took this action at the recommendation of the Stream Pollution Control Board.

The proclamation cited the fact that "Indiana ranks twenty-first in the United States in stream pollution control with only 59.7% of our urban population being served with sewage treatment." This lack of protection for the State's "beautiful natural resources" he stated he believed to be "due to our failure to appreciate their importance in the economic balance of our State, and might be due to the apathy of all of us."

The Governor urged all civic clubs, chambers of commerce, social and recreational associations, newspapers, and radio stations to cooperate in the drive. "I issue this as a serious challenge to all who have it in their power to help bring about the stopping of the pollution of our streams and I feel certain that through this cooperation we may expect our great State to achieve its proper standing in the Nation, and to have the health of its people greatly improved," declared the Governor.

NEWS OF ENGINEERS

Personal Items About Society Members

Louis Mitchell, dean of the College of Applied Science at Syracuse University, was the recipient of the honorary degree of doctor of engineering from Clarkson College of Technology at Potsdam, N.Y., on June 17. The presentation was made following Dean Mitchell's delivery of the commencement address at the 49th commencement exercises of the college.

George B. Palmer has formed a company for the design and development of self-unloading ships and stevedoring equipment for the handling of bulk cargoes, with offices in the Fidelity Building, 600 Griswold Street, Detroit 26, Mich. Formerly chief engineer for the Michigan Alkali Company, the Wyandotte Terminal Railroad, and the Wyandotte Transportation Company, Mr. Palmer designed and developed the first commercially successful self-unloading ship.

Thomas G. Brown was recently promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. He is the commanding officer of the veteran 839th Engineer Aviation Battalion in the Philippines.

Karl B. Schilling, colonel, Corps of Engineers, U.S. Army, has received two awards—the Croix de Guerre of the government of France and our own Bronze Star Medal. The Croix de Guerre citation commended Colonel Schilling for his "outstanding leadership, courage under fire, and technical proficiency, which materially helped the allied forces drive the enemy from the soil of France." The Bronze Star citation emphasized his "determination, outstanding administrative ability, and devotion to duty." Colonel Schilling has been in the Army since 1916. His home is in San Antonio, Tex.

James E. Dunn, since 1938 district engineer of the Richmond (Va.) office of the Portland Cement Association, is now manager of the Washington office, 837 National Press Building, Washington 4, D.C.

Arthur T. Ippen has severed his connection as assistant professor of civil engineering at Lehigh University, where he was in charge of the hydraulic laboratory, in order to accept an appointment as associate professor of hydraulics at the Massachusetts Institute of Technology. Professor Ippen's appointment is part of a plan to expand the program in hydraulics in the department of civil and sanitary engineering at Massachusetts Institute of Technology, where he will be in charge of the work in fluid mechanics.

Shortridge Hardesty announces the formation of an engineering partnership with Clinton D. Hanover, Jr. (formerly chief of the Bureau of Bridge Design of the New York City Department of Public Works), under the name of Hardesty and Hanover, succeeding to the practice of Waddell and Hardesty. Their offices will be at 101 Park Avenue, New York 17, N.Y.

Warren B. Woodrich, lieutenant (jg), U.S. Naval Reserve, has been awarded the Bronze Star Medal "for meritorious achievement in action against the enemy on Saipan, Mariana Islands, June 15 and 16, while serving as shore party commander for a Marine Corps landing team . . . ."

Francisco Gomez-Perez resigned in July 1944 as senior engineer for the Mexican Commission of Irrigation in order to accept a connection with Lezama y Cortina, S.R.L., C.V., and since May 1945 he has also been connected with Cimentaciones y Construcciones, S.A. Both organizations have their headquarters at Gomez-Farias 4, Mexico D.F., Mexico.

Harry B. Corlett, previously an engineer with Ellison and King, of San Francisco, Calif., has accepted the position of chief engineer of the Herrick Iron Works at Oakland, Calif.

Thomas J. Sette, who at latest accounts was stationed in the Marianas, was recently promoted from the rank of lieutenant (jg) in the Civil Engineer Corps of the U. S. Naval Reserve to that of lieutenant.

Frederick Louis Weiss is now a civil engineer with the Oakland contracting firm of Stolte, Inc. Until lately he was in the U. S. Engineer Office at Sacramento.

James Norman Pease, colonel, Corps of Engineers, U.S. Army, has been awarded the Bronze Star Medal for "his work as commanding officer and supply chief on Guadalcanal from June 22 to December 13, 1944." At the time of entering the Army three years ago Colonel Pease was head of the engineering firm of J. N. Pease and Company, of Charlotte, N.C.

J. S. Dodds, professor of civil engineering at Iowa State College, has been appointed county civil engineer of Story County, Iowa, for the current year.

Dwight H. Bray, until recently director of maintenance for the Kentucky State Highway Department, has been promoted to the position of director of design in charge of the state's proposed $75,000,000 postwar road-building program.

Frank L. Dieter has been appointed city planning engineer of Durham, N.C. For the past six years Mr. Dieter has been

county planning engineer of Arlington County, Virginia, with headquarters at Arlington.

JOHN S. COTTON has severed his connection as senior engineer in the San Francisco regional office of the Federal Power Commission, in order to accept the position of chief investigating engineer of a staff assembled by the National Resources Commission of China for a nation-wide survey of river basins and hydroelectric facilities.

ROBERT S. MAYO is now a major in the U.S. Marine Corps, the rank representing a recent promotion from that of captain. Major Mayo, whose home is at Lancaster, Pa., is at present stationed in the South Pacific, where he is executive officer of a Combat Engineer Battalion.

JESSE B. SNOW retired on May 31, 1945, as chief engineer of the New York City Board of Transportation because of having reached the mandatory age limitation. His successor will be JAMES H. GRIFFITH, who has been with the Board of Transportation since 1913, except for a two-year period during the first World War. For the past year Mr. Griffith has been serving as deputy chief engineer.

MILTON F. DENAULT, who is on the staff of the U.S. Geological Survey, has gone to South America under the auspices of the Survey and is engaged on topographic mapping and other types of surveys on the Rio Doce. His headquarters are at Gouvernador Valadares, Brazil.

LEON H. ZACH and THOMAS A. MIDDLEBROOKS are recent recipients of the War Department's Exceptional Civilian Service Awards. The former is chief of the Site Planning Section, Engineering and Development Division, Office of the Chief of Engineers, Washington, D.C., and receives his award for planning layouts of posts, camps, and stations. Mr. Middlebrooks, who is principal engineer in the Office of the Chief of Engineers, is being honored "for the establishment, development, and practical application of soil mechanics in the Engineer Department."

CHARLES W. YODER, previously structural designer for the Eastern Region of the Pennsylvania Railroad, with headquarters at Narberth, Pa., has taken the position of structural engineer in the Milwaukee (Wis.) district office of the Portland Cement Association.

LEON GOTTLIEB was recently promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. He has been supervising the construction of airdromes on the Continent since D-day, and is a recent recipient of the Bronze Star Medal. Prior to entering the service—in 1942—Colonel Gottlieb was in the Alabama State Highway Department.

CYRIL O. GILLIAM, who formerly maintained an engineering and architectural practice in Phoenix, Ariz., is at present connected with the Ventura Engineering Company, general contractors of Phoenix, Ariz.

F. B. FARQUHARSON, professor of civil engineering at the University of Washington, has been appointed director of the engineering experiment station there. For the past year Professor Farquharson has been making extensive experiments on models of the Tacoma Narrows Bridge.

ROBERT WESLEY BRIGGS, ARTHUR G. HAYDEN, and GEORGE E. STREHAN announce the formation of a consulting engineering practice, with offices in New York City. Several members of the Society who are on the civil engineering staff of Columbia University will serve the new firm in an advisory capacity. These are D. M. BURMISTER, JAMES KIP FINCH, N. V. FEODOROFF, and W. J. KREFELD.

MALCOLM PIRNIE, New York City consultant and Past-President of the Society, received the honorary degree of doctor of engineering from Rensselaer Polytechnic Institute at the graduation ceremonies on June 22. Mr. Pirnie was the principal speaker at the exercises, declaring himself in favor of universal military training which, he asserted, "would not breed war but would lesson its likelihood."

JOSEPH W. BARKER, who will return soon to the deanship of the school of engineering at Columbia University after four years of service as special assistant to the Secretary of the Navy, was recently given the Distinguished Civilian Service Award by Under-Secretary Ralph Bard. Dean Barker was cited for his work in the Navy's V-1, V-7, and V-12 training programs for high school and college students in "filling manpower requirements."

HAROLD S. ELLINGTON, architect and engineer (Harley, Ellington, and Day), of Detroit, Mich., was recently elected president of the Engineering Society of Detroit.

LEWIS J. WORKMAN is now on the staff of Parsons, Brinckerhoff, Hogan, and Macdonald, for whom he is working in Bogota, Colombia. He was formerly with the U.S. Bureau of Reclamation, with headquarters in Denver, Colo.

WILLIAM O. HILTABIDLE, Commodore, Civil Engineer Corps, U.S. Navy, has been awarded the Legion of Merit Medal for "exceptionally meritorious service in planning and directing construction on Guam." In the citation accompanying the award, Admiral Nimitz stated that ". . . under Commodore Hiltabidle's outstanding planning and facility, Guam has now been developed into a large advance base for the successful prosecution of Pacific operations."

WILLIAM P. GREENAWALT'S resignation from the U.S. Naval Reserve has been accepted, effective June 30, and he has returned to Chicago where he will continue as partner in the firm of Young and Greenawalt. As commander in the Civil Engineer Corps, Mr. Greenawalt was commanding officer of the 81st Naval Construction Battalion during construction of twelve naval bases in the United Kingdom, and later had charge of rhino ferry operation, beach salvage, and beach camp construction and maintenance for Utah Beach during the Normandy invasion. He is the recipient of the Legion of Merit from the U.S. Navy and of the Croix de Guerre with Red Star from the Republic of France—the former for his part in the invasion of France and the latter for "exceptional service during the course of operations for the liberation of France."

HARRY VOUGHT, lieutenant commander, U.S. Navy, has been confirmed an associate fellow of the Institute of Aeronautical Sciences. Commander Vought is the Bureau of Aeronautics representative at College Point, and has cognizance over several aircraft corporations in the vicinity of New York City. He is a member of one of the most distinguished of pioneer aircraft manufacturing families, responsible for the production of the Navy fighter—the "Corsair."

EDWIN C. VOGELGESANG, private, U.S. Army, was recently assigned to the 64th Engineers in Manila as an aerial photographer and is now engaged in photomapping duties. His home is in Kirkwood, Mo.

NATHANIEL P. TURNER, JR., has been promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. On duty at Headquarters, Services of Supply, China Theater, Colonel Turner is chief of the general engineering division, with supervision over all construction and engineering projects.

EDWARD J. LANDOR, retired engineer of Canton, Ohio, was guest of honor at a surprise luncheon, arranged by prominent citizens of Canton, on May 19, the occasion being his ninetieth birthday. Before retiring, Mr. Landor for many years maintained a civil engineering and contracting practice in Canton, specializing in bridge building. He is the city's oldest Rotarian and has long been active in local public affairs.

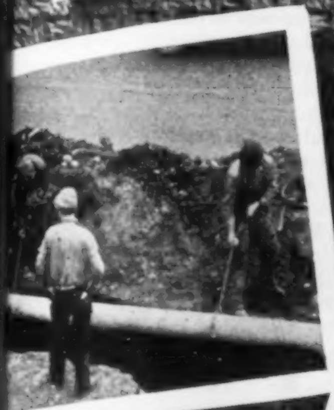
EWART G. PLANK has been nominated for promotion from the rank of brigadier general in the Corps of Engineers, U.S. Army, to that of major general. Similarly WILLIAM W. WANAMAKER has been nominated for promotion from the rank of colonel to that of brigadier general.

WILHELM D. STYER, lieutenant general, Corps of Engineers, U.S. Army, has been appointed commander of a newly established supply organization, called U.S. Army Forces, Western Pacific, which will take over the Services of Supply in General MacArthur's theater of war. Until recently General Styer was in the Washington (D.C.) headquarters of the Army Service Forces. His staff will include MAJ. GEN. EDMOND H. LEAVEY, formerly assistant chief of staff for logistics in the Pacific area, and BRIG. GEN. L. D. WORSHAM, previously assistant chief of engineers in charge of troops in Washington, D.C.

JAMES M. MONTGOMERY, Los Angeles consultant, was recently appointed manager of the Defense Plant Corporation's huge magnesium plant at Las Vegas, Nev., which until lately was managed by the Anaconda Copper Mining Company.

ELKINS M. HOWARD has been released from the Army, in which he served as first lieutenant in the Corps of Engineers, and is now general manager of the Jalan Textile Mills and Sugar Mills, Ltd., Tinsukia, Assam of India.

committees meet...



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DECEASED

WILLIAM JAMES BALDWIN, JR., (M. '12) retired engineer of Sarasota, Fla., died suddenly in Brooklyn, N.Y., on May 28, 1945, en route to Vermont for the summer. Mr. Baldwin, who was 72, spent his early career in the office of his father, William James Baldwin, a New York consultant. From 1897 to 1906 he was president of the Baldwin Engineering Company, and from the latter year to 1912 he maintained a consulting practice in New York. He then became chief engineer of the New York Steam Corporation, remaining with that organization until his retirement about six years ago.

MATTHEW MCCLUNG BIRD (Assoc. M. '20) general contractor of San Antonio, Tex., died at his home in that city on June 12, 1945. He was 57. A native of Tennessee, Mr. Bird was engaged in highway engineering there before moving to Texas almost twenty years ago. He was a member of the engineering and contracting firm of Bird and Becher, of San Antonio. Mr. Bird served in the first World War and was active in the work of the American Legion.

LEONARD DEMPSTER BROWNELL (Assoc. M. '07) district engineer for the New York State Department of Public Works, Utica, N.Y., died at his home there on June 12, 1945. His age was 67. From 1904 to 1912 Mr. Brownell was in the Office of Highway and Barge Canal Construction at Syracuse, and from 1912 to 1915 was resident engineer in charge of constructing barge canal terminals at Utica, Rome, Syracuse, and Buffalo. He served as district engineer in the New York State Department of Public Works at Syracuse until 1920, and since then had been district engineer for Oneida, Madison, Herkimer, Montgomery, Fulton, and Hamilton counties.

LEONARD ROBERT DROGIN (Jun. '40) corporal, U.S. Army, died in the Pacific on March 23, 1945. He was 27 and an alumnus of the college of the City of New York, class of 1939. For several years following his graduation, Mr. Drogin was with the Civil Aeronautics Administration—first in Washington, D.C., and then in Anchorage, Alaska, where he was assistant airways engineer in the construction of an airport. He went into the Army about a year ago and was assigned to an Aviation Engineer Battalion.

ROBERT PURL EASLEY (M. '35) senior partner in the engineering and contracting firm of Easley and Brassy, San Francisco, Calif., died in Oakland, Calif., on June 10, 1945. Mr. Easley, who was 58, had been in private practice in San Francisco since 1913. For much of this period he also operated the Roberts Island Dredging and Construction Company, Inc., at Antioch, Calif. Earlier in his career he was engaged in railroad work in California, and from 1911 to 1913 he was field superintendent for the Western Engineering and Water Supply Company on the installation of water and sewer systems in the West.

ERIK JOSEPH ERIKSSON (Assoc. M. '22) of Duluth, Minn., died there recently. He was 58. Mr. Eriksson was a native of Sweden, but was educated in the United States and spent his entire career here. From 1910 to 1932 he was with the Minnesota Steel Company—from 1916 on in the capacity of construction engineer. He then became civil engineer and safety director for the Duluth works of the American Steel and Wire Company, and from 1935 to 1943 was in the employ of the City of Duluth. During the latter period he served as engineer in charge of topographic surveying and mapping and as special assistant city engineer on the construction of a sewage-disposal plant.

JACQUES ANDRE FOUILHOUX (M. '16) New York City architect, died on June 20, 1945, as the result of a fall from the roof of a building he was inspecting. Mr. Fouilhoux, who was 65, was born and educated in France, coming to the United States in 1903. A leader in his profession, Mr. Fouilhoux designed the trylon and perisphere at the New York World's Fair and many other notable structures in New York and Chicago. He was one of the designers of Rockefeller Center, where his firm (Harrison, Fouilhoux and Abramovitz) now has its offices. Earlier in his career he was for some years a member of the New York firm of Raymond Hood, Godley and Fouilhoux. During the first World War Mr. Fouilhoux served as an artillery officer in the 129th Field Artillery.

GEORGE EDWARD HAWTHORN (M. '36) professor of civil engineering at the University of Washington, Seattle, Wash., died there on June 2, 1945. He was 55. From 1917 to 1924 Professor Hawthorn was with the Washington State Highway Department, serving for part of this period as chief draftsman. He then joined the staff of the University of Washington, where he was promoted through the various grades, becoming a full professor about two years ago.

SIGGE INGOLF ESBJORN HJORT (Assoc. M. '27) engineer for Leland S. Rosener, of San Francisco, Calif., died on April 28, 1945, at the age of 49. Born and educated in Sweden, Mr. Hjort spent his early engineering career there. From 1921 to 1925 he was in the Dutch East Indies, serving as engineer of design in the Royal (Dutch) Department of Public Works, at Batavia, Java. Coming to the United States in 1925, Mr. Hjort acted as draftsman for several California firms, and from 1927 to 1929 he was engaged on structural steel and conveyor design for the California and Hawaiian Sugar Refining Corporation. Since the latter year he had been engineer for Leland S. Rosener, of San Francisco.

CARL ROEMER JONES (Assoc. M. '37) colonel, Corps of Engineers, U.S. Army, Washington, D.C., died in that city on June 16, 1945, at the age of 41. An alumnus of West Point, class of 1929, Colonel Jones was promoted through the various grades from lieutenant to colonel. He was stationed at Fort Belvoir, Va., for four years, and later was at the Post of Corozal in the Canal Zone and at various engineer posts in the United States. For the past two years Colonel Jones had been in the Office of the Chief of Engineers, where he was chief of the Training Branch Plans and Training Division.

EMILIO GUAROA JOUBERT (Assoc. M. '31) of Monte Cristy, Dominican Republic, died recently. He was about 5[illegible]. Born in Santo Domingo City, Mr. Joubert was educated in the United States. Following his graduation from Cornell in 191[illegible] he was for a number of years in the Department of Public Works of the Dominican Republic. He was resident engineer and, later, district engineer in charge of road construction. Mr. Joubert had also been with the Compania Agricola Dominicana and, at one time, maintained a consulting practice in Santiago, Dominican Republic.

RUDOLPH GUSTAV KASEL (M. '38) chief of the Division of Surface Water, U.S. Geological Survey, Washington, D.C., died on June 14, 1945. Mr. Kasel, who was 4[illegible], had been with the U.S. Geological Survey since 1924—successively as assistant engineer, district engineer at Iowa City, acting chief of the Division of Surface Water, and chief of the Division of Surface Water. He was the author of *Water Resources of Iowa, 1873–1932*, and co-author of a number of U.S. Geological Survey water supply papers and technical reports.

FREDERICK WILLIAM LAFORGE (M. '04) retired engineer of New London, Conn., died on June 15, 1945, at the age of 81. From 1904 to 1930 Mr. LaForge was assistant engineer in the U.S. Engineer Office at New London, where he was in charge of the design, construction, and maintenance of fortification structures at the eastern entrance of Long Island Sound. He was then stationed at the Boston (Mass.) Army Base engaged in the development and maintenance of fortification structures in the 1st Corps Area, extending from Portland, Me., to New London, Conn. Mr. LaForge was a charter member and honorary member of the Connecticut Society of Civil Engineers. Long active in the Connecticut Section of the Society, he served as president in 1928.

RANSOME TEDROWE LEWIS (Assoc. M. '06) president of the Elmira Precision Tool Corporation, of Elmira, N.Y., died on May 17, 1945. Mr. Lewis, who was 77, spent much of his career in bridge construction. For some years he was manager of the Elmira plant of the Empire Bridge Company, and from 1917 to 1933 manager of the Elmira plant of the American Bridge Company. In 1937 he became president of the Elmira Precision Tool Corporation.

JOHN HERVID LUNDBERG (Affiliate '07) estimator of Butler, N.J., died on April 4, 1945, at the age of 65. A native of Sweden, Mr. Lundberg spent his entire engineering career in the United States. For some years he was engineer and general superintendent for the Church Construction Company, of New York City. He was also connected with the Monolith Reinforced Concrete Company, of New York, on various construction projects, and had been with Branch and Callanan, of Saranac Lake, N.Y. More recently he had been in the Construction Division of the Resettlement Administration in Washington, D.C.

CARLTON MANSON SOULE (M. '40) associate engineer for the J. E. Greiner Company, Baltimore, Md., died on June 28, 1945, at the age of 61. From 1910 to 1917 Mr. Soule was with the Baltimore and Ohio

Railroad; from 1919 to 1925, chief engineer for the Spencer Construction Company, of Baltimore; from 1925 to 1935, consulting engineer for Soule and Zepp, Inc., Baltimore consultants; and from 1935 to 1938, director of operations for District No. 1 of the Maryland WPA. Since the latter year he had been with the J. E. Greiner Company.

JOHN MERLIN WILSON (Jun. '42) lieutenant, U.S. Marine Corps Reserve, w killed in action on Okinawa on May 1945. He was 25 and a graduate of I State College, class of 1942. His ho was in Pyatt, Ark.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From June 11 to July 9, 1945

ADDITIONS TO MEMBERSHIP

AHLSTROM, CHARLES RAY (Jun. '45), Surveyman, U. S. Eng. Dept., Army Post Office 958, Care, Postmaster, San Francisco, Calif.

BOMZE, HERMAN (Jun. '45), 1416 Wythe Pl., New York 52, N.Y.

BORCHARDT, JACK ADOLPH (Jun. '45), Asst. San. Engr. (R), U.S. Public Health Service, 220 U.S. Courthouse, Portland, Ore.

BRAGDON, JOHN EMMONS (Jun. '45), Ensign, CEC, U.S.N.R.; 653 Sunset Rd., Waterloo, Iowa.

BRUST, ALVIN WALDO (Assoc. M. '45), Associate Prof., Civ. Eng., Washington Univ., Skinker and Lindell, St. Louis 5, Mo.

CARTER, EARLE HUGHES (Assoc. M. '45), (R. J. Tipton & Associates), 407 Colorado Bldg., Denver 2, Colo.

COBB, RALPH VALE (Jun. '45), Ensign, CEC, U.S.N.R.; 1234 North Isabel St., Glendale 7, Calif.

CROSBY, GORDON EUGENE (M. '45), Chf. Res. Engr., Stone & Webster Eng. Corp., 161 Devonshire St., Boston, Mass. (Res., 118 Lynnview, Fountain City, Tenn.)

DARNALL, LLOYD LAVERNE (Jun. '44), Ensign, CEC, U.S.N.R., Commander Service Force, Pacific Fleet, Care, Fleet Post Office, San Francisco, Calif.

DE METROPOLIS, TED (Jun. '45), Sgt., U.S. Army; 148 East 18th St., New York 3, N.Y.

DOBELL, CURZON (Assoc. M. '45), Vice-Pres., The Preload Corp., 420 Lexington Ave., New York 17, N.Y.

DOUTHITT, ROY WILL (Jun. '45), Ensign, CEC, U.S.N.R.; 454 Eleanor St., Schenectady 6, N.Y.

DUNN, WILLIAM ELLIOTT (Jun. '45), Salem, Ala.

EDGERTON, JAMES BRYANT (M. '45), Senior Engr. (Civ.), U.S. Engrs., Industrial Trust Bldg. (Res., 119 Sixth St.), Providence 6, R.I.

FULKERSON, EDWARD FLOYD (Jun. '45), Seaman 2/C, U.S.N.R.; 3634 Alabama St., San Diego Calif.

GEIL, GEORGE HENRY (Assoc. M. '45), Associate Engr. (Hydr.), U.S. Engrs., 800 Standard Oil Bldg. (Res., 5904 Marnat Rd.), Baltimore 8, Md.

GILLES, ROBERT ALBERT (Jun. '45), Lt., CEC, U.S.N.R., Care, Fleet Post Office, San Francisco, Calif.

GRAUL, HOWARD LESLIE (Jun. '45), Ensign, CEC, U.S.N.R.; West 1038 Kiernan Ave., Spokane, Wash.

GREEN, JACKSON DENISON (Jun. '45), Lt. (jg), CEC, U.S.N.R.; 207 Willow St., Delanco, N.J.

GRIFFIN, ALBERT DEVEREAUX, JR. (Jun. '45), Ensign, CEC, U.S.N.R.; 411 South Westmoreland Ave., Los Angeles 5, Calif.

GROVE, MARMADUKE (Jun. '45), Stress Analyst, Republic Corp., 42 Broadway, 6th Floor, New York 4, N.Y.

HERRICK, WILLIAM THOMPSON (Jun. '45), Ensign, CEC, U.S.N.R., Care, Fleet Post Office, San Francisco, Calif.

HETZLER, MORRIS CLIFFORD (Assoc. M. '45), Mgr. and Co-owner, Hill Top Produce Market, Illinois Ave. (Res., 177 West Wadsworth Circle), Oak Ridge, Tenn.

HOGAN, BEN FRANCIS (Jun. '45), Associate Mech. Engr., Industrial Laboratory, Navy Yard, Mare Island (Res., 197 Goethe St., San Francisco), Calif.

HRBEK, JOSEPH WILLIAM (Jun. '45), Ensign, CEC, U.S.N.R., Care, Fleet Post Office, San Francisco, Calif.

JOHNSON, ROBERT WILLIAM (Jun. '45), Ensign, U.S.N., Care, Fleet Post Office, San Francisco, Calif.

JOHNSON, WILLIAM SPENCER (Assoc. M. '45), Asst. Engr. of Contracts and Specifications, State Highway Dept., 1739 West Jackson St., (Res., 1626 East Pinchot Ave.), Phoenix. Ariz.

JOHNSTON, STEPHEN EARLE (Jun. '45), Ensign, U.S.N.; 4906 North East 23d Ave., Portland, Ore.

KAYANAN, ANTONIO CRUZ y (Assoc. M. '45), Civ. Engr. and City Planner, Commonwealth of the Philippines, Malacanan Palace, Manila, Philippines.

KIRBY, HAROLD LOUIS (Jun. '45), Eng. Inspector, Seaboard Airline Ry., Seaboard Airline Bldg. (Res., 324 West 27th St.), Norfolk 8, Va.

KORNER, GERHARD (Jun. '45), Civ. Engr., Dept. of Main Roads, 309 Castlereagh St. (Res., 63 New South Head Rd., Vaucluse), Sydney, N.S.W., Australia.

KRICK, JAMES HUYETT (Jun. '45), Structural Engr., The Austin Co., 16112 Euclid Ave. (Res., 2200 Prospect Ave.), Cleveland 15, Ohio.

LANG, JOHN JACOB (Assoc. M. '45), Secy.-Engr., Comm. on Plan, 400 Municipal Bldg., Baltimore 2, Md.

LOBEL, IRVING (Jun. '45), Stress Analyst, Edo Aircraft Co., Flushing (Res., 1211 Wheeler Ave., New York 59), N.Y.

LUPPRIAN, DAVID PHILLIP (Jun. '45), With U.S.N., Care, Fleet Post Office, San Francisco, Calif.

McCLAIN, DANIEL WAKEFIELD (Jun. '45), Asst. Div. Engr., Great Lakes Dredge and Dock Co., 17 Battery Pl., New York 4, N.Y.

McCOY, HAROLD JAMES (M. '45), Cons. Engr., Old National Bank Bldg., Spokane 8, Wash.

McCRIGHT, BOYD GRANT (M. '45), Chf. Carpenters Mate, U.S.N.R., 328 City Hall, Cincinnati, Ohio.

MACKS, MORTON JOSEPH (Jun. '45), Ensign, CEC, U.S.N.R., Care, Fleet Post Office, San Francisco, Calif.

MAIER, EUGENE (Assoc. M. '45), Col., Coast Artillery Corps., U.S. Army, H.A.A.A.C., Army Post Office 958, Care, Postmaster, San Francisco, Calif.

MASLANKA, THADDEUS RAYMOND (Jun. '45), Structures Engr., Curtiss-Wright Corp., Airport Plant (Res., 2439 Delaware Ave.), Buffalo 16, N.Y.

MATHEWS, WILLIAM KELSEY (Jun. '45), Ensign, U.S.N.R., Care, Fleet Post Office, San Francisco, Calif.

MONTGOMERY, GEORGE DEWEY (Assoc. M. '45), Insp. for Constr., 8th Naval Dist., Public Works Dept., Federal Bldg. (Res., 4662 Arts St.), New Orleans 17, La.

TOTAL MEMBERSHIP AS OF JULY 9, 1945	
Members	6,266
Associate Members	7,954
Corporate Members	14,220
Honorary Members	36
Juniors	6,568
Affiliates	76
Fellows	1
Total	20,901
(July 10, 1944	20,053)

MONTGOMERY, WALTER LEON (Assoc. M. '4 Constr. Engr. and Surveyor, Magnolia Pe leum Co., Box 900 (Res., 4421 Cowan St. Dallas 9, Tex.

MOORE, HUGH, JR. (Jun. '45), 2d Lt., Corps Engrs., U.S. Army; R.D. 3, Easton, Pa.

NELLE, FRANCIS RAYMOND (Assoc. M. '4 Constr. Engr., Gargaro Co., Inc., 40 East Mile Rd., Detroit 3, Mich.

ORGA, TEMEL HALIL (Jun. '45), Golcuk D Fabrikalari, Izmit, Turkey.

OVERFELT, IRA EUGENE (Jun. '45), Asst. Research Engr., Calif. Inst. of Technology, 250 We Bridge, Pasadena, Calif.

PERCY, RAY HOWARD (Assoc. M. '45), Const and Maintenance Engr., State Highway Dept (Res., 19 Jefferson St.), Helena, Mont.

PERRY, WILLIAM GREGORY, JR. (M. '45), Ch Constr. Engr., J. E. Sirrine & Co., Greenville S.C.

REA, DALE HOWARD (Assoc. M. '45), Engr. U.S. Bureau of Reclamation, 404 Custom house, Denver (Res., 3709 South Cherokee St., Englewood), Colo.

REAMES, PHILIP JOHN (Assoc. M. '45), Const Engr., Bureau of Yards and Docks, U.S.N. Naval Air Station (Res., 5122 Homer St.), Dallas 6, Tex.

REINGOLD, LOUIS (Jun. '45), Junior Civ. Engr. James Allen Tuck, 1 Exchange Pl., Jersey City N.J. (Res., 1341 Fifty-Sixth St., Brooklyn 1 N.Y.)

RENOVICH, STEPHEN, JR. (Jun. '45), Draftsman (Eng.), Chf. Engr's. Office, Southern Pacific Co., 65 Market St., Room 1060, San Francisco 12, Calif.

ROSCOE, CHARLES MILTON (Jun. '45), Ensign CEC, U.S.N.R.; 1236 J St., Eureka, Calif.

RUDIN, LEO (Jun. '45), Structural Detailer, Am. Bridge Co., Ft. of Warren St., Trenton N.J. (Res., 853 Elsmere Pl., New York 6 N.Y.)

RYAN, PHILIP LACKEY (Jun. '45), Engr. Asst. Stone & Webster Eng. Co., Tyner (Res. Route 6, East Shallowford Rd., Chattanooga 4), Tenn.

SALDANA, JUAN ANGEL (Jun. '45), Asst. to Design Engr., Beavers & Lodal, Transit Tower, Room 1411, San Antonio, Tex.

SCHMIDT, HARRY EDWIN (Jun. '45), Ensign, U.S.N.R., Care, Fleet Post Office, San Francisco, Calif.

SCULLEN, EDWARD JOSEPH (Jun. '45), Lt., CEC, U.S.N.R., Public Works Dept., Naval Air Station, Daytona Beach, Fla.

SERTELL, JAMES YULE (Jun. '45), Ensign, CEC U.S.N.R.; 3834 Winthrop Ave., Indianapolis 5, Ind.

SHANNON, ASA VANCE (M. '45), Prin. Engr. Corps of Engrs., U.S. Army, U.S. Engr. Office, Denison, Tex.

SNAPP, WAYNE FRANCIS (Assoc. M. '45), Chf. Eng. Estimator, U.S. Engr. Dist., 751 South Figueroa St. (Res., 628 North Commonwealth St.), Los Angeles 4, Calif.

STARR, FISHER MORRIS (Assoc. M. '45), Engr. Bethlehem Steel Co., Bethlehem, Pa.

STEPHENSON, JAMES BYRON (Assoc. M. '45), Civ. Engr. II, State Highway Comm. (Res., 635 Fillmore), Topeka, Kans.

STEPHENSON, RUSSELL ALLEN (M. '45), Bridge Constr. Engr., State Highway Comm. (Res., 812 Powers St.), Helena, Mont.

TIHONOFF, VLADIMIR DANIEL (Assoc. M. '45), Structural Engr., H. A. Brassert & Co., East 40th St. (Res., 226 West 71st St.), New York 23, N.Y.

TRESTER, HAROLD CHARLES (Assoc. M. '45), Engr. (Structural), Cook & Brown Lime Co., 70 Marion St., Oshkosh, Wis.

VOGLER, JOHN ROLLINGS (Assoc. M. '45), Capt., Corps of Engrs., U.S. Army, Engr. Research Office, 37 West 39th St., New York 18, N.Y.

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